THE MODEL ENGINEER

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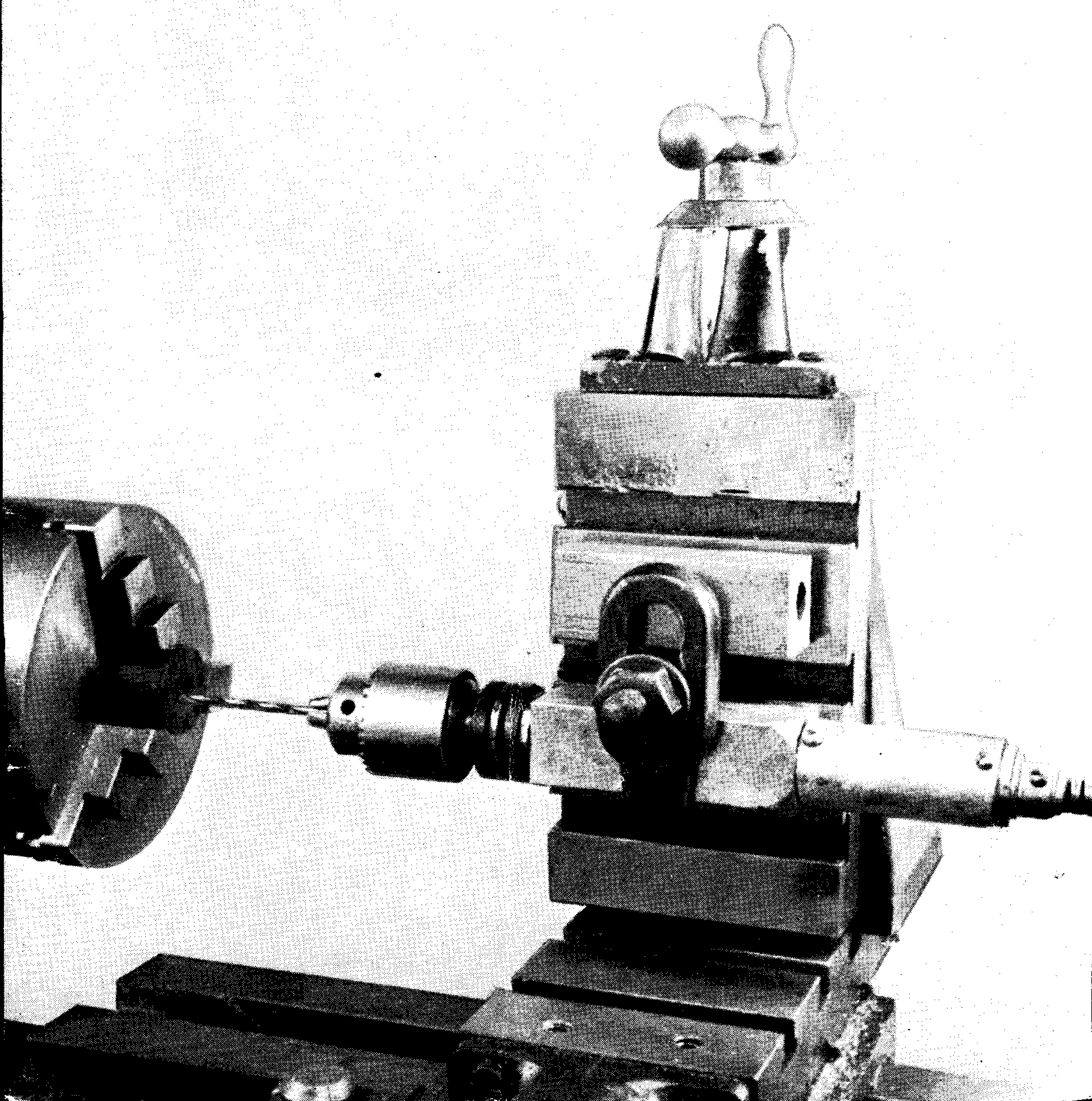


The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

25TH SEPTEMBER 1952 VOL. 107 NO. 2679

SMOKE RINGS

Anticipation

● THERE IS now scarcely a month to go before the opening of the "M.E." Exhibition, and, as usual, the preparations are rapidly approaching the climax. To say that excitement is reaching to fever heat would be to give an entirely wrong impression of what is taking place "behind the scenes" at this end. The Exhibition Organisers work steadily and patiently, as soon as one "M.E." Exhibition has come and gone, to prepare for the next one. They are a team to whom excitement is something to be avoided at all costs, just as in the case of any model engineer who is engaged upon a sizable job in his workshop. One slip might cause a serious delay to the smooth progress of the job; therefore, the preparations must be carefully planned so that any difficulties may be seen and, as far as possible, overcome before the job is started.

Present indications are that the 1952 "M.E." Exhibition will be a memorable one, especially with regard to the quality of the exhibits. The loan section, this year, will be particularly impressive; for, in addition to the novel Celebrities Stand which will include a selection from the cream of past Championship Cup winners, the late Dr. Longridge's ship model masterpieces, Nelson's *Victory* and the clipper ship *Cutty Sark*, will be on view, through the kind co-operation of the Director and staff of the Science Museum, South Kensington.

The first of our usual "What to see at the Exhibition" articles will be published on October 16th, and others will follow. Subsequently, our editors and others will be contributing critical reviews of the various aspects of the show, and these always create much interest, and discussion!

During recent years, there has been a steadily progressive improvement in the general quality of the work displayed at the "M.E." Exhibition; greater care is being taken in the building of models to scale or, at least, in the proper proportioning of all details. In working models, exact scale proportions of all the details cannot be expected; but, with due care, gross distortion can always be avoided, and we have noted, with satisfaction, that good work in this direction is becoming more and more apparent. Let us hope, that this year, the most auspicious in the history of the "M.E." Exhibition, our critics will be able to praise accuracy of proportions rather than condemn the opposite.

Railroadiana

● WE WOULD call the attention of our readers to the National Book League's exhibition of railway books, prints and relics, now open at 7, Albemarle Street, London, W.1; it will remain open until November 5, and the times are: Mondays, Wednesdays, Fridays and Saturdays, 11 a.m. to 5 p.m.; Tuesdays and Thursdays, 11 a.m. to 8 p.m. In connection with the exhibition, a series of lectures has been arranged; each lecture takes place on a Tuesday evening at 7.30 p.m. On September 30th, Mr. C. Hamilton Ellis will talk about "The Railway in Fiction," while on October 7th and 14th the speakers will be, respectively, Mr. G. Royde Smith on "Early Railway Personalities" and Mr. L. C. Johnson, J.P., on "Railway Archives."

Admission to the exhibition is free to members of the National Book League; non-members 1s. 3d., children 6d.

Calling Wolverhampton

● WE HAVE received a letter from the Wolverhampton Model Engineering Society, written over the names of J. P. S. Jones, C. Farman, H. R. Jones, E. Sockett and L. Crane. These gentlemen ask us to draw the attention of the former members to the fact that the society still exists, though sadly depleted to the five active members mentioned.

What has happened to the enthusiasm shown during the construction of the track at Wombourn? The track has been in use for the past two years; at present, it is laid for 3½-in. and 5-in. gauges, and there are hopes of laying 2½-in. gauge as and when membership and funds permit.

It is suggested that any past member who is still interested in the society should make a point of calling at the track pavilion between the hours of 10.30 a.m. and 1.30 p.m. on any Sunday within four weeks of the publication of this note. Otherwise, the remaining five members intend to re-name the society and make a fresh start. Past officers of the society are especially requested to note this and to forward any records of the society to Mr. J. P. S. Jones, 6, Alexandra Road, Penn, Wolverhampton.

We cannot believe that any past member would deliberately let the old society down, and we sincerely hope that this note will cause all of them to rally round and put the society on its feet again. Lone hands in the district may be interested in lending their support. A Corporation bus from Queen Street, Wolverhampton, at 10 a.m. on Sundays runs to Wombourn, and the track is at the Mount Pleasant Hotel, Oundsdale, Wombourn. So, come along; let us hear that the Wolverhampton Model Engineering Society is once more a going concern!

Traction Engines at Hull Docks

● REFERRING TO the letter from Mr. G. S. Shepherdson, published in our June 2nd issue, Mr. K. Birkby, of Sowerby Bridge, has paid a visit to Hull Docks and has sent us a long report on the old traction engines he found there. He also sent a number of photographs which, however, were not suitable for reproduction.

There has lately been some publicity in the newspapers concerning scrap being sent abroad, but Mr. Birkby is emphatic that such reports are incorrect. Three men are engaged in dismantling one engine a day, often working to as late as 10 o'clock at night; the scrap is loaded into nearby railway wagons labelled for our own steel furnaces in parts of the Midlands and the North.

Most of the engines were in reasonably good condition, the best being a Ruston Hornsby in excellent trim; the paint on it seemed quite new and parts of the motion looked like bright silver. Very obviously, this engine had been well cared for.

An unusual engine was a large Fowler which had a long, slender boiler, with a smokebox which projected about 15 in. in front of the chimney, all carried on massive steel wheels; it looked as if it had once been a ploughing engine, but there was nothing to show that a plough had ever been fitted. The suggestion has been made that this engine was one that had been built for Russia, in the 1914-1918 war, but never sent there; a winding drum was fitted under the boiler and intended to be used for hauling guns into position.

Some of the engines bore evidence of acts of vandalism; lubricators had been wrenched from their mountings and left lying limp on the boiler side; injector caps had been removed and replaced by sand and pebbles! A puzzling feature was that some of the washout plugs had been taken out and wooden bungs driven in.

Finally, Mr. Birkby asks for information as to which was the last showman's engine built by Foster; report has it that this engine was No. 14634, named *Princess Marina*, which, after it had stood for some years in the shops, was delivered to Mrs. T. Drakeley, in 1936. We believe that this report is correct, but we would like confirmation, or correction, of it.

Exhibition at Aylesford

● ON SATURDAY, August 30th, we had the pleasure of attending the Cobdown Show, the annual event organised by the staff of the Aylesford Paper Mills, near Maidstone. In addition to the usual outdoor sports, we found large marquees devoted to displays of art and crafts, fur and feather, horticulture and model engineering, respectively while outside there were two portable passenger-carrying tracks in operation. We enjoyed it all, but the model engineering display naturally claimed our chief interest. Locomotives, ships, power boats, steam engines, working model railways and a car-racing track made up a very striking display which attracted a constant stream of visitors throughout the afternoon.

One of the steam engines claimed to be "the smallest in the world," a claim that would probably be very difficult to substantiate, we think. We would be prepared, however, to regard it as probably the smallest oscillating engine, in view of the fact that its total height is about ½ in. It contrasted strangely with a fine old model beam engine working under air nearby.

We feel that all concerned are to be congratulated upon not only getting together so varied a selection of models, but also upon arranging them to such advantage; each exhibit could be examined easily and in comfort, and the general quality of workmanship was of a very satisfactory standard.

A Complete Flexible Drive Unit

by
J. B. Clegg, A.M.I.P.E.

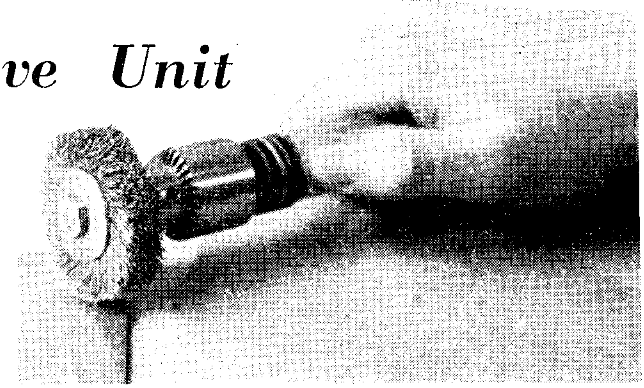


Fig. 1. *Polishing with wire brush*

ALTHOUGH I am frequently scorned for suspending work on the current model for the purpose of making a gadget or perhaps carrying out some alteration to the layout of the workshop, it has been observed that these diversions have a habit of paying dividends in the form of accurate results or work produced with a minimum amount of labour. The desire for a toolpost grinder was a long-standing one, so when a particular need for this accessory came along the usual interruption to steady progress set in and the spice of variety was again added to the pleasures obtained from the hours spent in the workshop.

The various methods of driving a portable grinder were compared and it was finally decided to use a portable drive unit and flexible shaft transmission, which enables the tool to be applied to a wide variety of purposes either with or without the lathe. One such use is illustrated in Fig. 1 where a piece of aluminium plate is being polished with a wire brush to give a pleasing surface finish without the laborious process of removing any scratches such as are usually present on random material.

Drilling and Grinding Head

Fig. 2 shows the spindle without chuck, complete in its holder and connected to the flexible shaft. This unit is also shown in detail in the sectional drawing, Fig. 3.

To make the spindle (Fig. 4) a piece of $\frac{5}{8}$ in. diameter mild-steel bar was mounted between centres with a carrier and turned to the dimensions shown, leaving ample surplus length between the carrier and the end of the Morse taper chuck arbor where it was to be cut off later. Turning between centres allows the work to be reversed at any stage for access to various faces, and there is no need to carefully scheme a method of completing the whole of the machining at one setting. This is particularly convenient when setting over the top-slide to turn the taper. My top-slide is not marked for setting angles, so I mounted a chuck arbor between centres as a guide for setting over.

Items shown in Figs. 5 to 9 were turned to suit the spindle, diameter x being made to suit a ball thrust-bearing of the type obtainable from cycle accessory shops. The two thrust washers, Fig. 5, were made from mild-steel and case-hardened. It will be seen that the bronze bushes, Figs. 6 and 7, have bores of

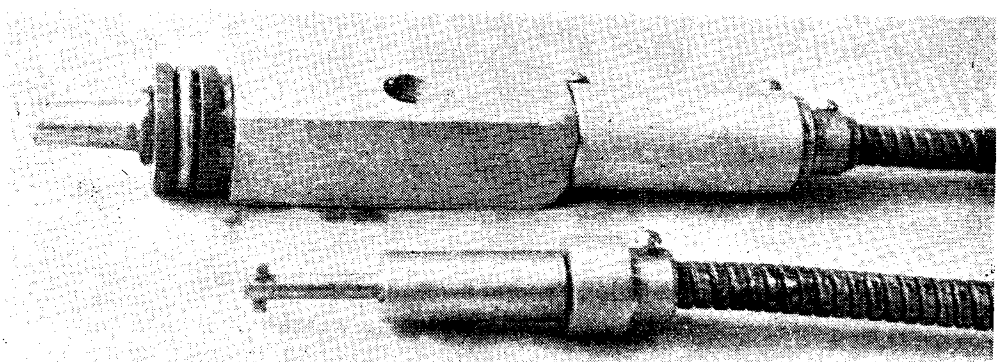


Fig. 2. *Spindle and drive coupling*

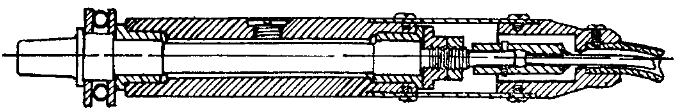


Fig. 3. Sectional assembly

and tempered and fixed with a 6-B.A. grub-screw to the setting necessary to bore the required diameter. It may be practically impossible to adjust such a simple boring tool to finish the precise diameter given on the drawing, but this is not important when the bushes can be turned to suit the bore. The boring tool was inserted through the work-piece with carrier already fixed on driving end, rotated between centres and the slide fed by leadscrew until the cutter had machined out the required depth of

different diameter so that the larger one may be easily passed over the first land on the spindle and still be a suitable size for a lapping on its own portion. Care was taken to bore both bushes a tight push-on fit so that they could be lapped after final assembly. The making of these bushes, however, was deferred until they could be turned to press into the holder.

The holder, Fig. 10, could very well be made from a piece of 1 in. square bar and left that size if bright drawn. Aluminium is preferred for light handling, but this does not prohibit the use of mild-steel in these days of restricted choice. Actually, a suitable piece was sawn from an aluminium casting and machined all over to the dimensions shown. For this purpose the casting was mounted in the toolpost and all four sides faced with a fly-cutter, which is one of my favourite devices and has been used on many occasions. The cutter is simply a $\frac{3}{8}$ in. square, short lathe tool mounted in an adaptor which was made from $1\frac{1}{4}$ in. diameter mild-steel bar slotted to take the tool at an angle of 45 deg. to the axis of the lathe mandrel. The tool is fixed by two

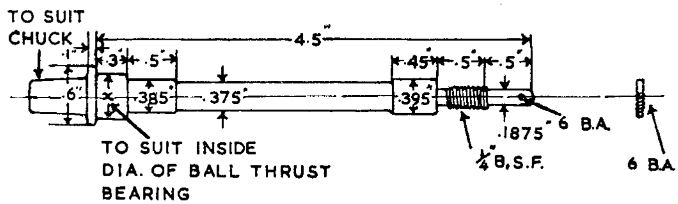


Fig. 4. Spindle

bore at one end. The boring tool was then inserted through the opposite end without disturbing the cutter and the carrier changed over to opposite end of bar. The lathe was then run in reverse and leadscrew operated for left-hand feed, thus boring both ends alike and in true axial alignment.

The bushes, Figs. 6 and 7, were each turned and bored at one setting to be a press fit in the holder and a lapping fit on the spindle. A simple way of pressing in is to use a $\frac{3}{8}$ in. diameter bolt held by its head in the vice. Place the holder, with bushes entered, over the bolt, fit a washer and nut and tighten until bushes are pressed home.

Both brushes were pegged (6-B.A. pegs not shown in drawings) to prevent turning and the whole lapped on spindle revolving in three-jaw chuck using jewllers' rouge as a medium. The extension left on the spindle was useful at this stage for chucking and was only cut off after completing the lapping and removing the holder.

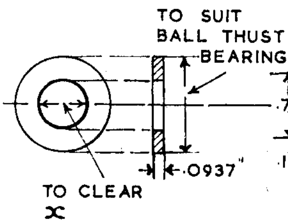


Fig. 5 (2 off)

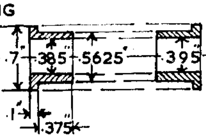


Fig. 6 *Fig. 7*

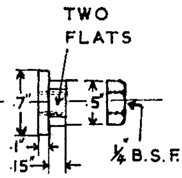


Fig. 8 *Fig. 9*

$\frac{1}{4}$ in. screws tapped through the metal on one side of the slot. The stub of the adaptor is tapered No. 2 Morse to fit in the lathe mandrel where it is securely held by means of a $\frac{3}{8}$ in. diameter draw-bolt screwed in the small end and extended through the hollow mandrel, then fitted with a spigotted washer and nut.

After facing, the squared piece was centred at one end, packed up to correct height on the cross-slide and fixed parallel with the lathe bed. A $\frac{7}{16}$ in. drill was chucked in the lathe to drill through lengthwise in preparation for boring. A boring bar was made from $\frac{3}{8}$ in. diameter silver-steel drilled through for a cutter fashioned from a piece of 5/32 in. diameter silver-steel hardened

The spindle having been cut to length, was re-chucked with taper end out and the 0-$\frac{1}{4}$ in. chuck off my No. 1 Champion drilling machine tried on with a smearing of marking blue. The high

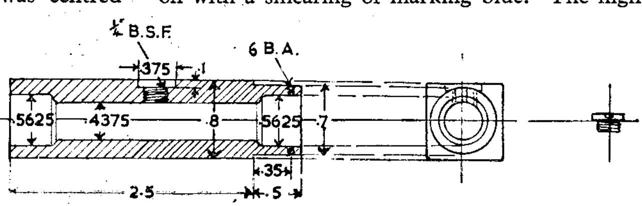


Fig. 10. Holder

places thus indicated were rubbed down with emery-cloth glued on to a stick until the chuck was a firm fit. No attempt should be made to achieve this fit by turning, as the spindle cannot be expected to run sufficiently true in this setting and the original turning of the taper should be accurate enough to ensure that very light rubbing

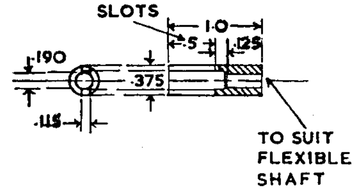


Fig. 11

down should enable a perfect fit to be attained.

Returning to the holder, the ends were faced by chucking in the four-jaw and the rear end turned down to 0.7 in. diameter, which is the internal diameter of a piece of aluminium tubing used for the connecting sleeve (Fig. 13). The

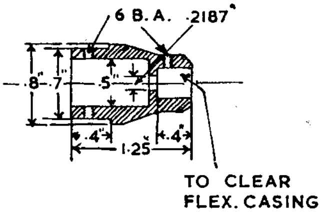


Fig. 12

sleeve is a push fit on the holder so that the flexible driving shaft may be easily detached after removing the two fixing-screws. It sometimes facilitates setting up for a machining operation if the drive is so uncoupled during the procedure of fixing the holder in a position requiring precise setting. The photograph on the cover of this issue, shows such a set-up where the spindle is mounted on the vertical slide for drilling a circle of holes in a piece held in the lathe chuck.

Before leaving the holder, provision for charging with grease was made by drilling and tapping the $\frac{1}{4}$ in. B.S.F. hole and recessing with an end-mill to take the flat-headed screw which is sunk to clear clamps.

Drive Shaft

The connecting sleeve having had the ends squared in the lathe, the adapter, Fig. 12, was turned from aluminium, fitted in and secured with two 6-B.A. screws. A 6-B.A. screw secures the flexible shaft outer casing into the end which is bored to suit. An *ex*-aircraft flexible drive

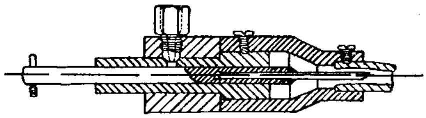


Fig. 14

was purchased for this item and was of sufficient length to make several such shafts.

The coupling, Fig. 11, was turned from mild-steel, slotted, and soldered to the flexible drive shaft which was then inserted into its casing. The inner shaft was cut to leave approximately $1\frac{1}{4}$ in. projecting from the casing and the drive-end coupling, Fig. 15, also made from mild-steel was then soldered on.

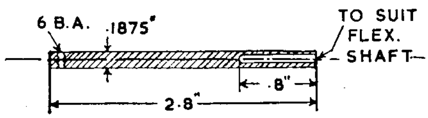


Fig. 15

Another aluminium adapter, Fig. 19, was fitted by slipping it over the soldered coupling and fixing on the outer casing as before.

A bronze bearing, Fig. 18, was slipped over the coupling and fixed in the adapter before inserting the driving pin, which is simply a

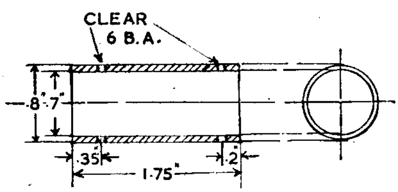


Fig. 13

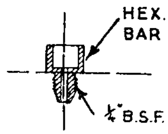


Fig. 16

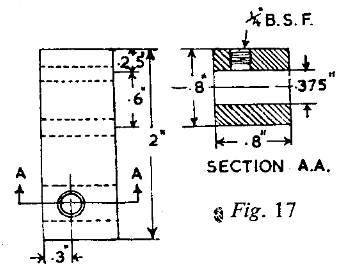


Fig. 17

6-B.A. steel bolt screwed in until threads bind, then cut off both ends to project equally for an overall length of just under $\frac{3}{8}$ in.

The drive-end coupling is aligned in its bearing to run true with the driving shaft by means of a fixing into which the $\frac{3}{8}$ in. diameter stem of the bearing is an easy push fit. The fixing, Fig. 17, was made from another piece of the cast aluminium as used for the spindle holder, but almost any material would be suitable. An oil hole in the bearing registers with the $\frac{1}{4}$ in. B.S.F. tapped hole in the fixing so that the

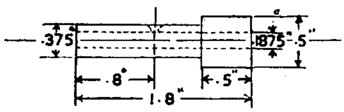


Fig. 18

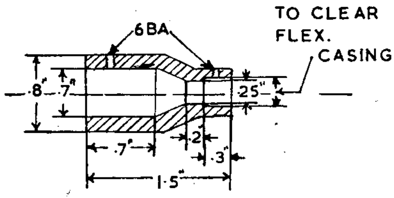


Fig. 19

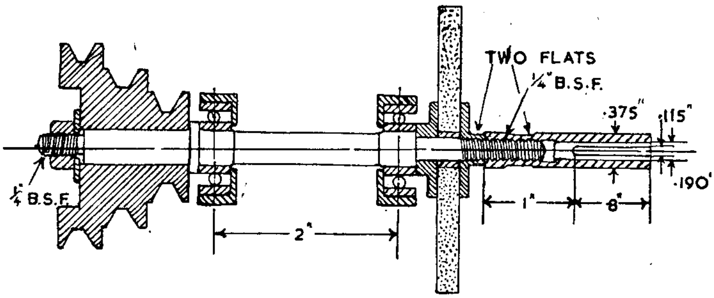


Fig. 20. *Sectional arrangment of countershaft*

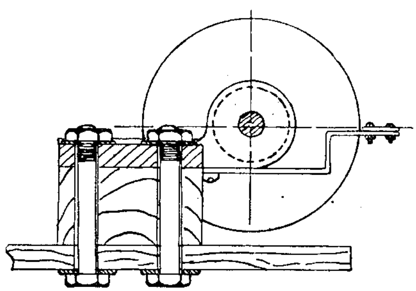
fitting of the oil cup, Fig. 16, holds the bearing secure, yet allows it to be easily removed. The flexible drive is thus quickly removed for stowing away, or to enable a small grinder on the drive unit to be used for sharpening drills, etc.

The Drive Unit

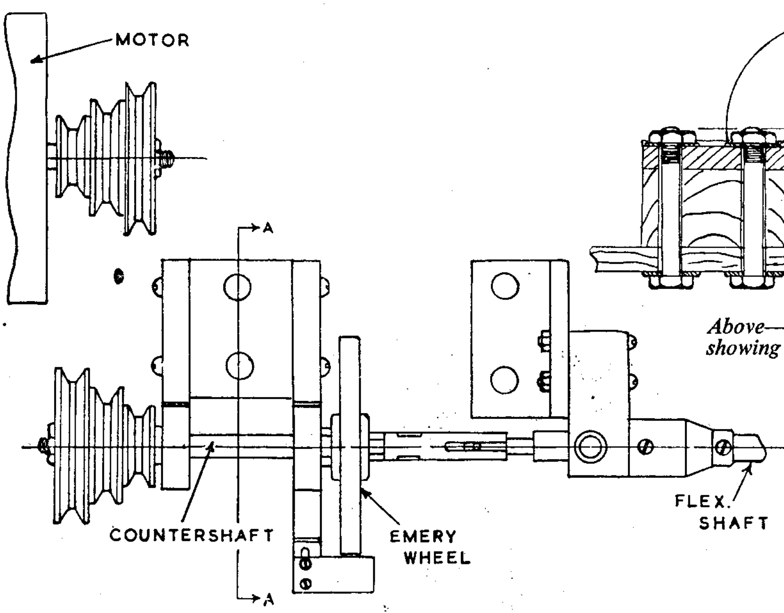
A converted motor generator, advertised as ⅛ h.p., is mounted on a baseboard which has four rubber feet fixed to the underside. A countershaft serves the dual purpose of mounting a 3 in. diameter × ¼ in. grinding wheel for light tool sharpening on the bench and providing a choice of three speeds. Fig. 20 illustrates the countershaft spindle complete with grinding wheel, driving sleeve for flexible drive, and mounted in bearings.

The spindle was turned between centres from ⅝ in. diameter mild-steel bar, the bearing lands being finished to size with the aid of the micrometer to suit the ball journal bearings after trying these on a piece of ⅜ in. diameter silver-steel to determine the precise diameter. The housings for these bearings were cut from ½ in. thick mild-steel flat bar to the profile as shown in Fig. 22, and bored by clamping to the face-plate. The bearing housings, fixed by screws to the sides of a piece of flat bar, are bolted to the baseboard with a packing block between.

(To be continued)



Above—Fig. 22. *Section AA, showing countershaft bearing*

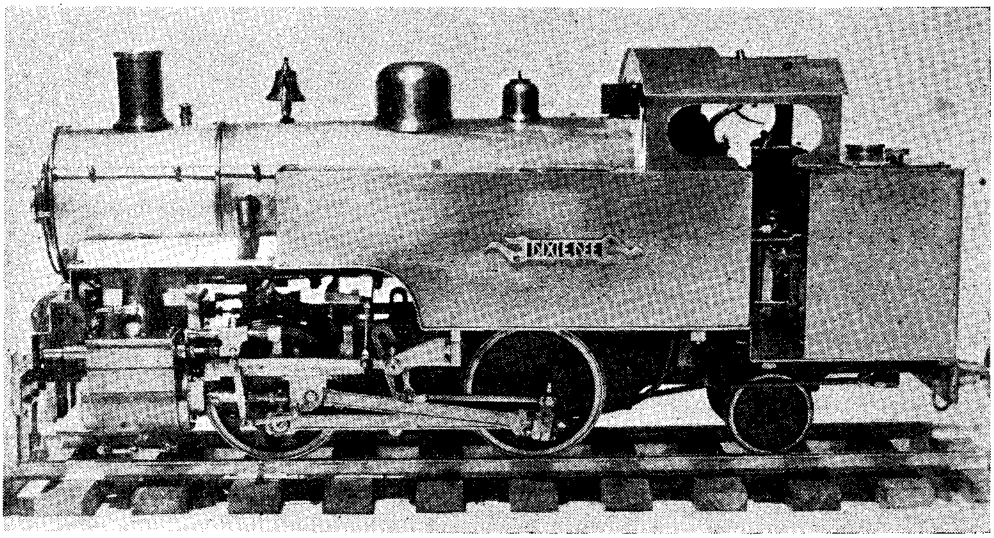


Left—Fig. 21. *Plan of drive*

"L.B.S.C.'s" Lobby Chat

Whistles Across the Sea

WHEREVER the sound of a full-sized locomotive's whistle is heard, there also can be heard the voice of her small sister. Just recently, time of writing, a long letter accompanied by a batch of photographs, came to hand from Harry L. Dixon, the secretary of the Pacific Region of the American Brotherhood of Live Steamers (nothing "toyshoppy" about *that* title!) giving an account of their latest doings, which may be of interest to followers of these notes on the British side of the big pond. The Pacific Brotherhood is going strong, as there are over 300 members on the register, including your humble servant, although it is unlikely that I shall ever be able to take advantage of running my locomotives on their track. Harry says that the correspondence entailed slows down the work in his own shop, but considers it well worth while. I'm troubled with the same complaint; when my present jobs will be completed, goodness only knows! I can work fast enough in my workshop, but am terribly slow at writing and drawing, which I guess is Nature's way of striking a balance. The boys over yonder wanted me to write for their new magazine, *The Miniature Locomotive*; but unfortunately from their point of view, it is as much as I can do to carry on with my present commitments, and to do more is a physical impossibility.



Harry Dixon's tank engine

A Neat Tank Engine

One of the reproduced photographs shows friend Dixon's 0-4-2 tank engine *Dixie Dee*, and another shows him driving it, accompanied by a four-legged lady passenger carrying a ball in her mouth. The locomotive is Harry's own design, and incorporates both British and American practice. She is certainly a far better-looking machine than the old Forney tanks which operated many suburban services on U.S.A. railroads before the coming of Milly Amp. She uses liquid fuel, in a "Shattock" burner. The line is of very substantial construction, though of irregular shape, as the picture shows. Note the typical American water tank. As to the engine, she incorporates some interesting features, among which is the valve spindle guide, which takes the form of a small edition of the main guide-bar and crosshead, the combination lever being suspended from the crosshead pin. Disc wheels are used, the coupled wheels having circular holes all around the big bosses. A mechanical lubricator having a drum tank is fitted, feeding into the steam pipes directly above the steam chests; and that typically British fitting, the spring-controlled side buffer, can be seen on the rear beam. Everything is either built up or cut from the solid.

"Old Soldiers Never Die——"

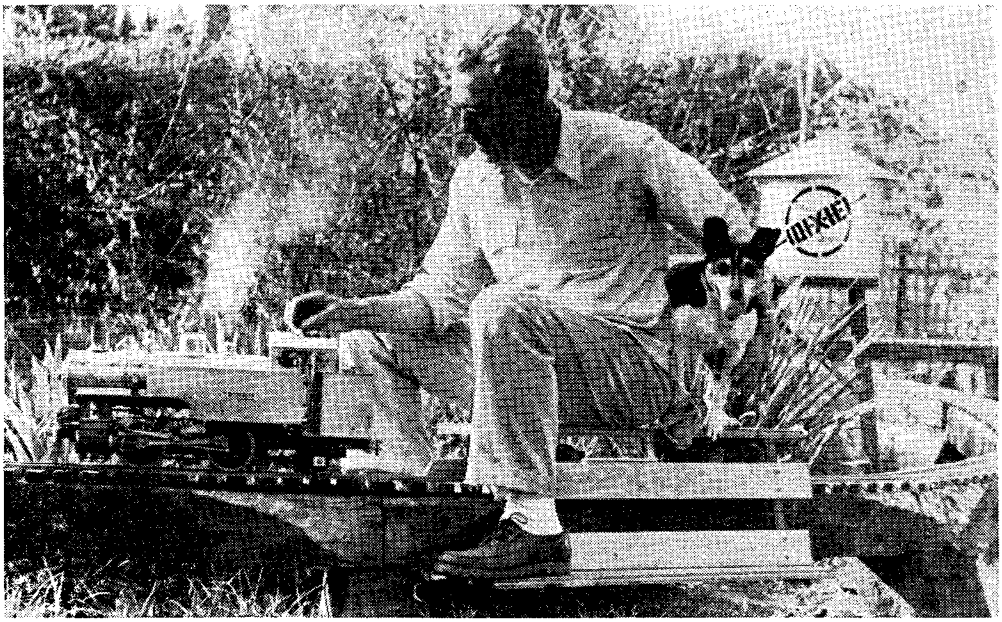
One of the photographs which gave your humble servant great pleasure to see, was that of two old friends of mine, to wit John Matthews and *Charlotte*, his Illinois Central Atlantic locomotive, which gained a medal at one of the "M.E." Exhibitions a quarter-of-a-century ago,

for hauling a load of seventeen passengers; no small feat for a $3\frac{1}{2}$-in. gauge four-coupled engine of normal dimensions, and a bit of a sockdolager for the tractive-effort-adhesive-weight "experts." John took his well-earned retirement from business some years ago (boy—*am* I jealous!) and removed from the windy city of Chicago to sunny California, which he says isn't always as sunny as it is supposed to be. *Charlotte* naturally accompanied the family, but *she* hasn't retired—not on your life! In the picture, John is firing her up, all ready for a spot of hard pulling on the Golden Gate Live Steamers' track at Oakland. Harry Dixon took a turn at driving her, and says she goes as well as ever, the exhaust beats being all quite even. *Charlotte* knew my old line at Norbury well enough, as she stayed with me during the time John and his family were in this country in 1927. They naturally wanted to travel around a bit, visiting relations and old friends, and John said he wanted to leave the engine some place where it would be in safe keeping. I put a $3\frac{1}{2}$-in. rail in the old "Norbury Light"—previously $2\frac{1}{2}$-in. gauge only—especially for *Charlotte's* use, and I saw to it that she didn't go rusty! Two of her interesting features are, a horizontal tube whistle on top of the boiler, and a boiler feed pump under the right-hand side of the cab, driven by a long eccentric-rod connected to the return crank.

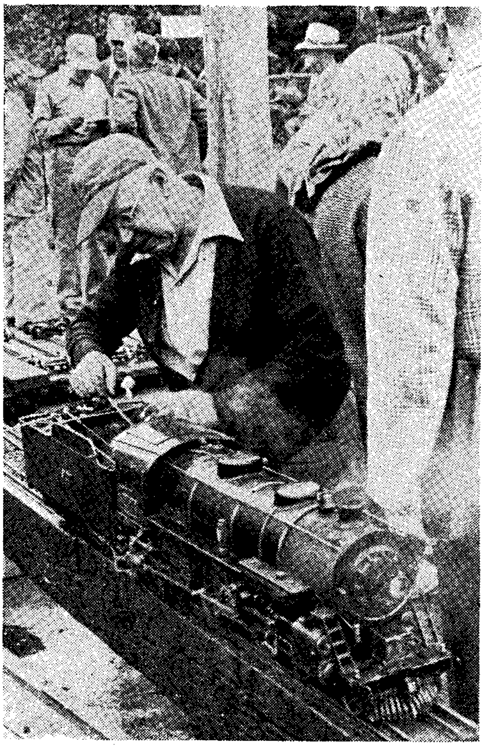
Driver Joy's "Opposite Number"

Incidentally, the Pacific Region of the Brotherhood doesn't consist exclusively of brothers. One of the photographs shows the worthy secretary's daughter Dauna Dee Dixon (what a lot of D's!) about to start on a run with a big 4-6-6 Boston and Albany tank engine belonging to Capt. G. B. Kubicek (hope I've spelt that right, some of the names are a wee bit different to our Smiths, Browns, and Joneses) and very business-like she looks, too. None of the old newspaper and magazine stunting about it, either; Dauna is a capable locomotive engineer, and runs Harry's tank engine on the home road, often with the dog Dixie as passenger. Speaking of stunt pictures, I happened across a shining example of "where ignorance is bliss," in an American magazine forwarded by a friend in Connecticut. This magazine had an article about "live steam," written in the usual twenty-per-cent fact and eighty-per-cent. imagination style of the lay reporter, and was illustrated by several pictures of little locomotives, one of which portrayed an old-time 4-4-0 about $7\frac{1}{4}$-in. gauge; the driver, sitting in the tender, was a girl *in a bathing costume*!! Those of us who actually run little locomotives, know well enough that they will throw sparks, spots of hot oil, and sometimes drops of sooty water from the chimney when starting away or pulling hard, and we take the necessary precautions to protect our anatomy. You can see by the picture that Dauna Dee wears suitable clothing for the job. What would have happened to the bare skin of the bathing belle if she had actually tried to drive the engine is just nobody's business; the local drug store would have probably had a rush order for any preparation that would relieve burns and scalds!

It is hardly necessary to add that the girl was the magazine's stock photographic model—I've



No barking!



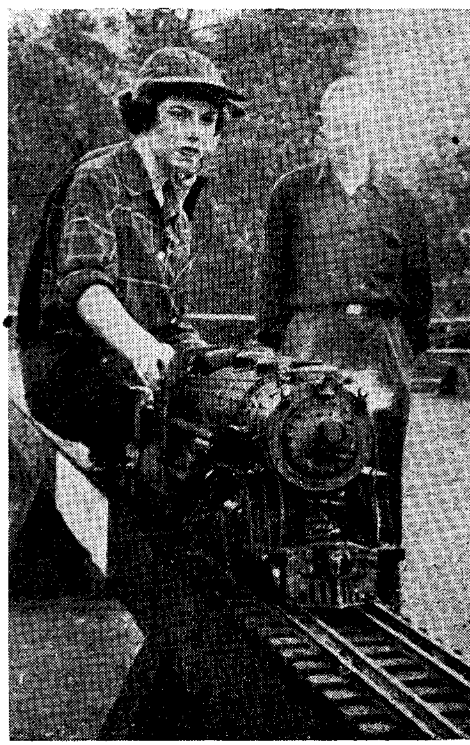
Two old veterans still going strong

seen a picture of her, in another issue of the same magazine, sitting on the bonnet of an automobile, and wearing the same costume—and I'll bet that the car engine hadn't been running for some time, or she would have needed cold cream or lotion for a portion of her anatomy not visible in the picture! Anyway, such stunt pictures apparently please the uninitiated, so we'll let it go at that. Returning to the Boston and Albany tank engine, she was built many years ago, and her present owner bought her from Bill Hill of San Diego; but she is now out of service, as the worthy Captain has, alas, been reported as missing in North Korea. The Brotherhood members are earnestly praying that he is still alive, and will return to them in the not-too-distant future; I hope so, too. *What* a blessing it would be if *everybody* on *both* sides, decided to pack up and go home!

Double heading the Carlisle Goods!

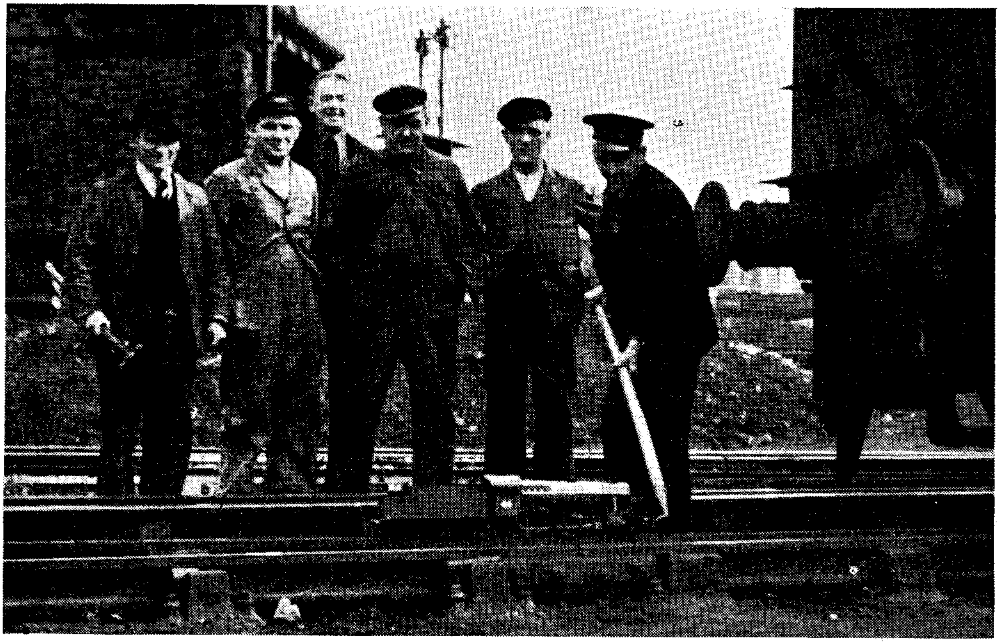
The amusing picture reproduced here, was sent by Mr. E. W. Eccles who hails from the town of the same name, near Manchester, and the scene is British Railways 10 C sheds. Apparently, the driver of the engine, the tender of which can just be seen, thought that the load would be too much and wanted a pilot, which the yard inspector, Mr. Bentley, promptly supplied by sending along his own *Dyak*. I hope the weight of the coupling didn't break the shunter's pole! Anyway, apart from its humorous aspect, the picture illustrates in a striking manner, the difference in size between a $2\frac{1}{2}$-in. gauge locomotive and its full-sized relation. One can easily realise why uninitiated folk often refuse to believe that 80 lb. pressure in the little engine's boiler is equal to 80 lb. pressure in the full-sized article. I forget whether I ever recorded it in these notes, but many years ago, when I mentioned that fact to one of the Brighton enginemen, he just laughed it to scorn; so I asked him to borrow a full-sized gauge from the stores, and bring it along. I coupled it up to one of my little locomotive boilers and got up steam; and the look on his face when the big gauge needle went around nearly to 85 before the safety-valve lifted, would have made his fortune at Hollywood! The point that the unbelievers overlook, is the difference between pressure and volume.

This difference also led to the "scale pressure" fallacy. Certain people argued that if a locomotive is built to, say, one-sixteenth of full size, it should work with one-sixteenth of the pressure. Nothing of the kind! It should work with a proportionate *volume* of steam, at the *same* pressure; but as steam pressures of over 100 lb. per sq. in. are not necessary on our small engines, we keep below that figure, and save having to make super-strong boilers. I mention the above, because several beginners have written to me on the subject. All they want to grasp is that any given



They're not all *brothers*!

pressure *per square inch* on the metal of the big and little boiler is the same, although the little boiler may only contain a teacupful of steam, and the big one may hold many cubic feet of steam. Our scientific friends combine pressure and volume into *weight*, and could calculate the weight of steam needed to work a pair of cylinders 20 in. bore and 28 in. stroke, and the proportionate weight of steam needed for an equivalent job by a pair $1\frac{1}{4}$ in. bore and $1\frac{3}{4}$ in. stroke. The larger cylinders would need a bigger volume of steam to fill them, *at the same given pressure* and that is all there is to it.



Hooking on the pilot

Reverting to the photograph, it was taken by another shunter, with a Zeiss Contessa camera; but as Mr. Eccles forgot to mention his name, I am unable to make a suitable acknowledgment. However, that will be remedied in due course, for he says he will be glad to take some close-up photographs of valve gears, and other useful items, which might be handy for our locomotive-building friends. Offer accepted with grateful thanks.

New Wine in Old Bottles

A reader recently wrote to me about a "museum piece" that he had purchased in a junk shop for a few shillings, and wished to recondition it, if possible, to haul a live passenger. The engine, judging from his description, is of a type that was "standard" about 60 to 70 years ago, sold in "model" shops for about £3 to £5 according to size. I have here at the present minute, an old catalogue issued by a Macclesfield firm just before the end of the nineteenth century. On page 21 there is a picture of a very hybrid 2-2-2 with a very eulogistic description underneath, reading "Powerful slide-valve locomotive, with outside cylinders $\frac{3}{4}$ in. bore $1\frac{1}{4}$ in. stroke, with reversing eccentrics (here follows some blah) bright relieved brass boiler $2\frac{1}{2}$ in. diameter, $8\frac{1}{2}$ in. long (more blah) starting lever in front of boiler, same as used on large locomotives (apparently a very important feature) waste steam to blow up funnel (ditto !) with spirit lamp complete. Length $14\frac{1}{2}$in., capable of travelling at 10 miles per hour (gee-whiz ! Accent on the 'whiz') price 65s." A really priceless description, fully guaranteed to attract the cash of enthusiastic schoolboys, whose testimonials fill several pages of the catalogue. I don't have to point out to followers of these notes, that a plain "pot" boiler of the size given, with three open and unprotected spirit flames underneath, would hardly make steam enough to supply $\frac{3}{4}$ in. $\times$ $1\frac{1}{4}$ in. cylinders, even in still air. The least puff of wind would deflect the flames from under the boiler, and prevent it steaming, while the effect of a 10-mile-an-hour dash would probably put them out !

Actual Specification

The frame is a cast brass rectangle with six lugs on it, the $\frac{3}{16}$-in. iron wire axles running in plain drilled holes in the lugs. The wheels are spidery brass castings, with treads about $\frac{1}{8}$ in. wide, and flanges less than $\frac{1}{16}$ in. thick; the gauge is $3\frac{7}{8}$ in. The cylinders are of stationary-engine type, attached to the underside of the frame casting, ahead of the leading wheels, by two screws in each. The piston-rods are extended, and pass

through plain guides, also screwed to the underside of the frame casting. The crossheads are small blocks of brass attached to the piston-rods by a single 3/32-in. set-screw, which also carries one end of the connecting-rod, a flimsy strip of metal with a drilled hole at each end. The tiny steam chests project under the frame casting, the exhaust pipes coming out underneath in two U-bends, the free ends just going into the chimney, which is a bell-topped tube passing vertically through the front end of the "pot" boiler. The valve gear consists of two small brass loose eccentrics, the rods of which are made from 3/32-in. iron wire, flattened at the end to fit the valve spindle forks. No provision at all is made for cylinder lubrication.

The boiler is a piece of brass tube with stamped disc ends soldered on, and it sits in an oblong hole in the frame casting, which the catalogue calls a "bedplate." It has a dummy dome, a tiny organ-pipe "squeaker" whistle attached to a long-handled cock, and a combined spring safety-valve and filler just in front of the skimpy brass weatherboard. The much-vaunted "starting lever" is an angle cock, the pipe from which goes down and runs along the side of the frame, to the cross pipe between the steam chests. Incidentally, if the galoot who designed the engine had taken the pipe straight through the lamp flames, the efficiency (such as it was!) of the engine would have been increased by 100 per cent. Another case of "where ignorance is bliss!" There are two test cocks on the back end of the boiler, and four teapot knobs for buffers. A bit of brass, bent channel-shape and screwed to the rear end of the frame, simulates a bunker, as there is no tender.

Hints for Rebuilding

The above specification tallies with that sent by my correspondent, and despite the apparent hopelessness, it is possible to make the old crock do the doings, by giving it the same treatment as I gave poor old *Ancient Lights*. If the original builder saw her scooting around my little railway with an adult passenger, waggling her tail, and blowing off all the time, he wouldn't believe the evidence of his own eyes; in fact, she surprised me on her first trial run. I'll ever remember that rebuilding job, as I finished testing the boiler just as the first "doodlebug" warning sounded. We got no sleep that night; and for the next three months, not more than 15 minutes' sleep without a break. Such is modern "civilisation!" Well, here is a brief summary of what to do with the honourable relic.

Saw the frame casting lengthwise, right down the middle, and file away sufficient to allow a measurement of $3\frac{1}{8}$ in. outside the lugs (axle bearings) when the halves are butted together again. Silver-solder the joint, and put a strap across under the footplate, and across the front end, for extra strength.

Leave the driving axle bearing plain, but slot the leading and trailing lugs and fit small axle-boxes with springs, one spring pin to each. File the bottom ends of the lugs square, and screw the hornstays direct to them.

Bend up circles of $\frac{1}{8}$-in. square brass rod to the diameter of the wheel flanges; silver-solder one to the back of each wheel, then turn up the reinforced wheels as near to my "standard" dimensions for tread and flange, as they will allow. Make new axles of mild-steel, $\frac{1}{4}$ in. for driving axle, $\frac{3}{16}$ in. for leading and trailing. Distance between backs of wheels should be 3 9/32 in. Fit new eccentric sheaves of steel, and put one in the middle for a pump. The *Tich* pump can be used, bracketed to the frame casting.

Put a reamer through cylinder bores, fit fresh pistons and rods, and fit new back covers turned from *Tich* or similar castings, with guide-bars, crossheads, and connecting-rods of *Tich* pattern, or any kind as may be fancied. Open out the ports as big as the steam chests will allow, make valves to suit, and fit fresh eccentric straps and rods, setting valves as per instructions previously given for loose eccentrics. Reinforce cylinder attachment by pieces of angle. The *Tich* arrangement of steam and exhaust pipes, and mechanical lubricator, can be used.

Make up a *Tich* boiler and smokebox, with either the larger or smaller barrel, just as desired, but lengthening the barrel and tubes to suit the job in hand. The original old chimney and dome casing can be used, to preserve the antiquated appearance; see photograph of old *Ancient Lights* in the *Live Steam Book*. Put on any fittings desired. Fit a fender (like a very short side tank) each side of firebox, and either a weatherboard or short cab, plus the *Tich* or *Juliet* bunker. In place of the old spirit-lamp container, fit a brass water tank, with filler and vertical hand pump projecting up through the footplate. Alternatively, leave out the bunker, and fit a separate tender, something like that which I specified for *Rainhill*, but longer, on six wheels. Add trimmings to taste (says Mrs. Beeton) and then one can truly say that "I, D'Arcy Lancelot Montmorency Smith, am the owner of a coal-fired passenger-hauling locomotive originally built sixty years ago." I believe old *Ancient Lights* is older than that!

Extracting Broken Taps

Broken-off screw taps are a problem to remove, particularly in small sizes, or where it is not practicable to heat and anneal the metal for drilling out. In such and other cases it is easy to remove them by chemical means. Melt some candle wax over and around the tapping hole Make a clear passage to expose the end of the tap through the wax; either end may be treated according to convenience. Next, pour in a few drops of pure nitric acid, obtainable from the local chemist. Repeat the acid treatment every few hours, until the steel tap is disintegrated, then wash away all traces of the acid, or neutralise with some liquid ammonia.

The acid works something like the electrical arcing method of removal, as it has a greater chemical affinity for the hard steel of the tap than the softer metal being tapped. Pure nitric acid is very corrosive on the skin, so treat it with special care.—WILLIAM E. THOM.

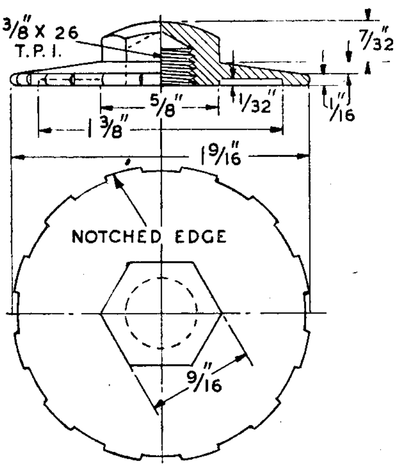
A Control Lever for the "Busy Bee"

by Edgar T. Westbury

THE cover plate may be made from an aluminium alloy casting, provided that the material is sound, but it will be better still if made from a hard alloy such as duralumin. An alternative form of construction would be to make this in the form of a light alloy washer, with a hexagonal hub of harder material, shouldered down and pressed tightly into its centre.

In either case, it is important that the tapped hole in the centre should be concentric, and square with the underside face, also that the thread should be well cut, to ensure the minimum risk of becoming stripped in use. Although not shown on the drawing, the end of the tapped hole may well be recessed or undercut, to relieve the tap when cutting the thread, and ensure that the cover will screw on the stud to the limit of the depth of the hole.

For the rest, it is only necessary to clean up the top face and mill or file the hexagon to a convenient spanner size. The notches in the edge of the disc may also be milled or filed,



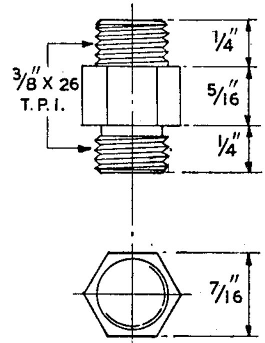
COVER PLATE
1 OFF DURAL

but a still more convenient method, for workers with limited equipment, is to use a shaping process, using a parting tool on its side, in conjunction with indexing of the lathe mandrel. Twelve notches are shown on the drawing, but the exact number is immaterial; an alternative would be a coarse knurl on the edge, with a modified form of check spring to engage the serrations; but the locking action will not be quite so positive if this method is adopted.

Continued from page 338 "M.E," September 11, 1952

Centre Stud

It will be seen that this is specified as hexagonal over the major diameter; the object is not only to facilitate screwing it in, but also to ensure that it is locked against unscrewing by the keep plates. Obviously, a square or any other regular or irregular polygon would serve this purpose just as well, if the holes in the keep plates are made to suit. In specifying the sizes of hexagonal



CENTRE STUD
1 OFF M.S.

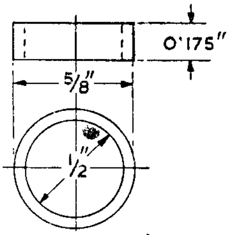
material, I generally state the nearest fractional size, and I am often reminded by readers that this does not correspond exactly to British Standards Specifications for hexagon bolts and nuts. My experience in buying hexagonal bars, however, is that they are more often than not odd sizes (none of the samples in my possession at present will fit standard spanners !) and one is generally very glad to be able to obtain any such material at all, without being so fastidious as to go around "miking up" any piece that is offered.

In the present case, it is clear that the exact size of the hexagon is of very little importance, but as the centre bush of the lever fits over the corners of the hexagon, this must be bored to the diagonal dimension of the latter. It is advisable, while the stud is set up for turning the lower threaded end, to check the concentricity of the hexagon by taking a light skim over the corners, just sufficient to show that the tool is touching them all. This will not impair the locking power of the hexagon, but will ensure that the bush is located concentric with the screwed stud.

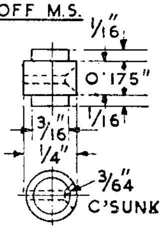
The lower end of the stud has an undercut at the shoulder, to ensure that it will screw fully home in the body. While the stud is still set up for screwing, the body should be tried on, to make certain that the position of the hexagon is correct to engage the keep washers when fully tightened. Any necessary correction can be made

by skimming back the shoulder slightly ; when the desired result is achieved, it may possibly be necessary to take a skim off the end of the stud to ensure that it does not project beyond the surface of the clamp seating of the body.

The concentricity of the screwed top end of the stud is not of vital importance, but should be reasonably true. My usual practice in making double-ended studs of this type is to neck down the reverse end to its specified size while still initially set up, before parting off. It is then



CENTRE BUSH
1 OFF M.S.



NIPPLE
2 OFF BRASS

reversed for screwing, and so long as it does not run badly out of truth, the die will follow it and produce a true thread.

Centre Bush

This can be turned and bored at one setting, the outside being a working fit in the bore of the lever, and the inside a push fit over the corners of the hexagonal stud. One could, of course, be " meticulous " and machine or file a hexagonal hole to fit the stud, but there is really no necessity for this at all in practice, and few constructors, I imagine, wish to spend time on operations which do not in any way improve the functional efficiency of the job. The length of the bush should be slightly less than the thickness of the lever at this point ; a decimal figure is given for this dimension to indicate that there is a definite difference ; but there is no need to work to fine limits, and the bush may simply be parted off with a keen tool to " minus $\frac{3}{16}$ in.", requiring little or no further machining.

Keep Plates

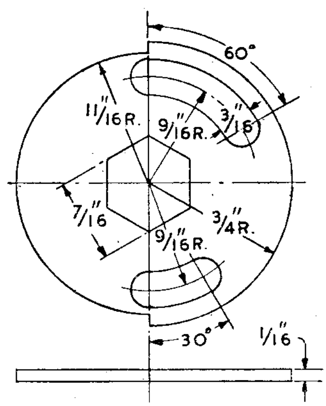
Apart from drilling, these require no machining, as it will be just as satisfactory to file them up from $\frac{1}{16}$ in. (or 16-gauge) sheet steel as to attempt to use any kind of machining process, except possibly turning the larger diameter portion of the edge, and boring the centre hole to the " across flats " dimension of the hexagon. After drilling a small hole in the centre, the two plates may be bolted together and dealt with as one piece for drilling and filing out the limit slots, and shaping the outer edge. Then, before removing the centre bolt, two smaller bolts through the limit slots may be used to preserve location while filing out the hexagonal centre, to fit the stud. It is rather unlikely that provision for more than one position of the stud will be necessary, but if desired, the hole could be made twelve-pointed (like the popular " star-angled-spanner ") to ensure maximum adaptability. All burrs should be removed and the surfaces of the plates finished as truly flat as possible.

It will be noted that these two plates act like the discs of a multi-plate clutch, to produce a controlled amount of friction on the sides of the lever, under the pressure of the spring. They need not necessarily be of metal, and sometimes vulcanised fibre or other non-metallic plates are preferred. These certainly give a smoother frictional effect, but in my experience are liable to be influenced by climatic conditions, and may swell considerably in wet weather so as to produce a stiff or sticky action. Steel or bronze plates, with a little graphite grease or similar lubricant on them, have been found more consistently reliable in this respect.

Thrust Washer and Spring Washer

A thin plain washer, which may be made of steel or brass shim stock about 0.015 in. thick, is fitted on top of the upper keep plate. This is only necessary because the limit slots in the keep plate prevent the latter being used as a surface to take the thrust of the spring washer.

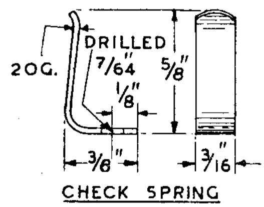
Any form of standard spring washer of con-



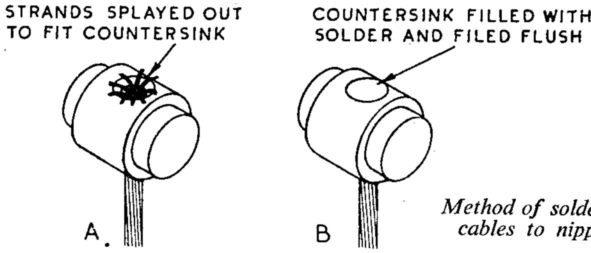
KEEP PLATE
2 OFF M.S.

venient size may be used in this control, but in some cases it may be necessary to modify the means of location in the cover plate, or provide a little more room between the latter and the thrust washer. The most convenient type of spring washer is one of the " saucer " type, which is very resilient, and takes up little end space. If a single washer of this type does not produce sufficient friction, two of them, both convex side up, may be used together.

In the event of no suitable washer being readily available, it is possible to make one from spring steel of about 20-gauge, such as an old joiner's scraper or handsaw blade, which should first be annealed, by heating to dull red and allowing to cool as slowly as possible, then filed or machined to shape, and then bent to a curve (in one plane) about $\frac{1}{8}$ in. high in the centre. It is then re-hardened by heating to redness and quenching out in water with a film of thin oil on the surface, and tempered to a dark blue by heating uniformly all over on a steel plate over a gas ring, or in a sand bath, and re-quenching. To assist in the latter operation, the washer should be scoured bright first, but as it will be very brittle after the first quenching it will need careful handling. Some samples of spring steel are supplied in a semi-hard condition, so that they can be worked without annealing and have sufficient elasticity to avoid the need for tempering ; but I regret that I cannot inform readers where to obtain this or any other suitable raw material, under present conditions of restricted supply.



CHECK SPRING
1 OFF SPRING STEEL



Method of soldering cables to nipples

Check Spring

This may be made of the same material, and dealt with in the same way, as the spring washer. An ordinary hacksaw blade (not the flexible type) is wide enough to provide the material in this case ; it will, of course, have to be annealed and re-tempered as described above. It is attached to the underside of the body by a single 6-B.A. screw, and care should be taken to see that the latter does not project inside the body to foul the lower keep plate, unless a hole is drilled in the latter to clear it. The spring should snap into the notches of the cover plate, and hold it positively in any position of adjustment, requiring to be lifted by the finger nail if any readjustment of the cover is desired.

Nipples

Hard brass " screw rod " is suitable for these and they may be turned at one operation from $\frac{1}{4}$ in. diameter material, as the outside need not be touched. Note that the length of this portion again must be slightly less than the thickness of the lever. The cross hole should not be larger than is necessary to pass the Bowden cable freely through it, as the security of the soldered joint is much impaired if the solder is required to fill up a wide gap. Most of the commercially-made nipples I have encountered leave much to be desired in this respect. The hole should be deeply countersunk on one side and de-burred on the other.

Fitting Cables

In dealing with the description of the " Busy Bee " engine, I assumed that readers would be familiar with the method of fitting Bowden cables ; but it appears that this assumption was not entirely correct, as I have received many requests for advice on this matter. Incidentally, I have found that some motor-cycle repair fitters do not seem to know too much about it either, to judge by some of the jobs I have encountered, so I will describe the methods which I employ, and which may not be " accepted practice," but produce satisfactory results.

First of all, I thoroughly tin the holes in the nipples, by applying flux to them and heating up over a bunsen burner or spirit lamp. The use of combined flux and solder, in the form of " solder paint," such as Fryolux, very much simplifies this operation.

The cable is also well tinned before fitting, but this is best done with a soldering-bit, owing to the risk of overheating, and thereby drawing the temper, of some of the strands of the cable, if a flame is used. It is best to allow a little spare length of cable so that one does not have to work at the extreme end, as this is liable to fray out and interfere with compactness of the strands, but these should in any case be coalesced by soldering to assist in getting them through the nipple, and it may then be found necessary to file surplus solder away before the cable will pass through the hole.

After threading the cable through the nipple as far as required—see that the cable is tinned at this point—it is gripped with a light pair of pliers or tongs (do not use your best pliers, as they may become softened by heating) so that the nipple rests on the jaws and is thereby located. The nipple is then heated, preferably by a blowpipe, to the fusion point of the solder, avoiding exposure of the cable to the flame, and if necessary adding just a little solder to fix it, but avoiding excess. Allow to cool, and cut off the cable about $\frac{1}{16}$ in. outside the nipple ; then with a small screwdriver or chisel, splay out the strands of cable to fill the countersink, as shown at *A* in the illustration. Using either a soldering-bit or a blowpipe, apply more solder to embed the strands firmly and fill any interstices, and after cooling off, file away projecting strands, flush with the surface of the nipple, as

(*Continued on page* 417)

"Co-Co"—by Bill Worrall (Reading S.M.E.E.)

The story of a 5-in. gauge experimental electric locomotive under construction

A TEMPORARY on-off switch and change-over ditto were wired in and lashed to the batteries. Upon switching on (full voltage is 24 V) in one "smack" the contraption started away easily and accelerated smoothly and had to be stopped by hand before it coursed off the rails. The temporary independent wheel springing worked well, climbing a $\frac{1}{4}$ in. difference in rail height (no fishplates !) with no trouble, although the tender gave trouble at the same spot.

The track received a little attention now, packing up the offending levels, and Dennis Gilder volunteered to be the first passenger. He sat astride the bogie batteries, and was shunted up and down a few times—weight 11 stone. We all had a go in turn and then a mishap occurred. Our rail joint went awry again and the whole outfit, plus passenger got mixed up on the floor, accompanied by a loud sizzling, flashes, blue smoke and frying smells ! Upon sorting the whole lot out, we found the batteries had suffered no damage, thanks to the heavy wooden cases ; tender and bogie were O.K., except that two motors were now out of commission, as their leads had fractured and shorted via the frames. Lastly, the passenger was not irreparably damaged !

Continued from page 370, "*M.E.*," *September* 18, 1952.

The motor leads were cut back and isolated, and tests recommenced. Again, we tried with one rider, now four motors only. Quite O.K., no fuss. Two of us sat on, one on the tender astride batteries, the other balanced on the running board. Still no sign of stalling. However, with a third sitting on the bogie, we reached the limit, that is, with the voltage available, 24 V nominal. Current was approximately 13-14 A for four motors. Even after a full hour of shunting up and down this short length of track, the motors were still relatively cool. The gears showed no sign of fatigue. They are on the light side distinctly, but were free ! (No cost, I mean.) In fact, referring to the gears, our critics have condemned these out of hand, saying they will strip when starting, strip when stopping, or in any case wear out quickly ! My comment on this is, that until they do go or experiments prove a different ratio is needed, they'll stay put.

The first haulage tests gave us the following figures :—Four motors at 24 V, 14 A, would move approx. 800 lb. at least. Speed : in the 10 ft. run before juice was cut off, walking speed was reached, say 3 m.p.h. All in all, I suppose one should be pleased with the results. One can assume from previous torque tests, that a 16-20 lb. T.E. was required to shift the 800 lb. load. With the twelve motors we can expect 2,400 lb. shifted. However, by impressing

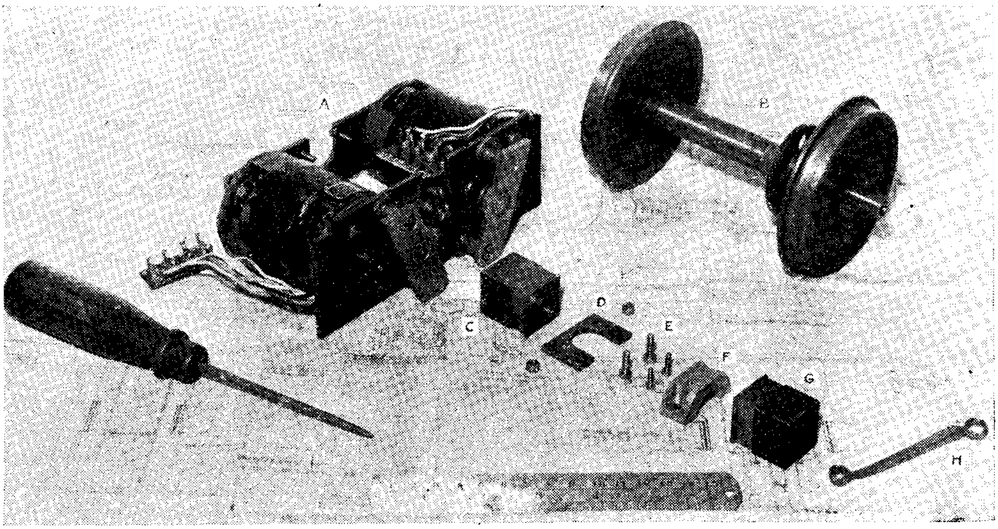


Photo by] [*M. H. C. Voake, M.P.S.*

Semi-exploded view of drive assembly. "*A*"*—motor assembly. Main half bearing housing between gears* ; "*B*"*—axle gear-wheel assembly. P.B. sleeves for axle mounting between wheels* ; "*C*" *and* "*G*"*—temporary axleboxes. Steel P.B. liners* ; "*D*"*—keep-plate for outboard axle bearing* ; "*E*"*—screws for* "*F*" ; "*F*"*—upper half main axle bearing housing* ; "*D*" *and* "*F*"*—clamp over P.B. sleeves on axle as at* "*B*" ; "*H*"*—spanner, to go in works* !

30 V full per motor, we should get a T.E. of 96 lb. estimated to haul some 3,500 lb. The motors will definitely stand up to 60 V for a short period, and the limits seem to be lack of adhesive weight and capacity of batteries to supply the juice, and available space in the locomotive itself.

Some work has recently been done on the springing details. The upper auxiliary spring brackets were fashioned from ½ in. dia. seamed steel tube from an old "brass" bedstead. The tube was parted off to length, opened out, beaten over a former to U-shape, silver-soldered to angle brackets and then sawn and filed to their peculiar shape. Temporary fixing to bogie sides is by a single 8-B.A. bolt. Eventually, two rivets will be used. The lower spring pockets were turned from ⅝ in. square bar. The auxiliary springs themselves are Triumph clutch springs calculated to deflect ¼ in. from free length at 10 lb.

The main leaf spring, which is loaded to reverse camber, a rather unusual feature, has been the subject of much calculation and experiment. As these springs are such a noticeable feature of this locomotive, I wanted to get the appearance right, coupled with good resilient working. Machinery's Handbook formulas were consulted and scaled down, which gave me the nearest leaf thickness of 0.036 in. I obtained this, and then remembered "L.B.S.C.'s" dictum on working leaf springs, i.e. three laminations per leaf. So I decided to try to use what material I had by inserting paxolin between alternative leaves. This works excellently; I should think, in fact, that a leaf spring made purely from this material would make an excellent job for small loads. The main springs have been made up and tested by spring balance and rule, although not yet tested under the actual conditions in the bogie. However, it is certain to work well. Old hacksaw blades were tried first but the punch kept splitting them.

An interesting job is rolling the spring eye of 0.036 in. material round a ⅛-in. pin, and still keeping end-to-end length correct. A tool and jig will be designed next to carry out this operation.

The loading per wheel we estimate to be approx. 20 lb. when batteries are carried. Lubrication is arranged by oil chamber and felt wads in the axleboxes.

The pivot and drag arrangements of the prototype are unusual. There is no centre pivot or king pin proper. Instead, two sector plates are mounted at approx. 4 ft. 6 in. radius on each main bogie stretcher. This has a raised box casting bolted to it, forming two parts of a female circle. The main chassis has two male sectors above each bogie to mate. Hence the bogies *push* the body. Does this illustrate the old argument? In addition, there are two side sectors much smaller and at a higher level, to prevent roll and side swing.

The four main bogie bearing sectors for the model, each formed from ⅛-in. plate as a base, have pegged to them a section of 9½ in. circle black iron, formed round a faceplate and cut into lengths, finally welded.

As soon as I have rigged up a faceplate on the milling machine these and their male counterparts will be turned up true and bolted in position.

To lessen friction as is on the usual club track with small continuous curves, we have designed a sector thrust and bearing race with special keep for the balls, instead of using a plain face as per the full-size job.

At the present moment a halt has been called on bogie No. 1, except for completing springing details, which will be tackled in one lot, in order to get bogie No. 2 to a working stage, as we are very much fired with ambitions to get the thing under way. To this end, a stout board will be used as a main chassis, carrying batteries and probably the driver, when further answers to our queries will doubtless be given. Actually this date, given the opportunity to carry out the work, will not be far distant; it is hoped, before the summer ends.

Although much remains to be done, we feel the back of the job is broken and, unlike a steam job, we shall be able to run before it even looks like an engine, following an old model railway motto—"Get something running"

A few further words on other items to be incorporated in "Co-Co"—braking equipment. Initially, we had thought of devising a rheostatically-controlled, solenoid-actuated braking system, but it has been decided to go the whole hog and fit reasonably correct working air brakes, and quite a few hours have been already spent on the necessary calculations. Triple valves will be fitted both on locomotive and car(s), and we have got the tubing for the auxiliary tanks. One seems to get quite a bit of repetition work on a double-ended job like this—"Co-Co" alone needs 24 complete sets of brake gear! It is thought of trying Tufnol or paxolin for brake blocks. The air compressor will be driven from a small auxiliary motor about 1/50 h.p. and worm-geared down to 250 r.p.m. Two swanee whistles would probably give the correct hooter note! So there will be life in it. Should the motors prove to get too hot under actual running conditions, we shall have to fit a blower and pipe some air through them.

The Control System

Ideas about this have changed once or twice. Wally is the expert in this department, and the latest decision is to use a smaller celled battery: i.e., Exide 10 V units, 20 of them in series. The six motors on each bogie will be in series across the 200 V at peak effort. A tapping switch will give coarse control, a rheostat fine control. The motors can also have a position of all twelve in series. Further, one stage of field weakening can be introduced to give us a turn of speed. Estimated maximum with present gear ratio is 8-10 m.p.h. with 1 ton load. Plans here are not yet complete and trials will provide some answers. Use of higher voltages will cut down currents and cable size. A multi-way cable as jumper to driving car is one idea for control, another by key insertions on to drive spigots through either end of locomotive. The first is favoured as D.M.H. speed and reverse control, brake and whistle controls are needed.

Earlier in the article I mentioned electrifying

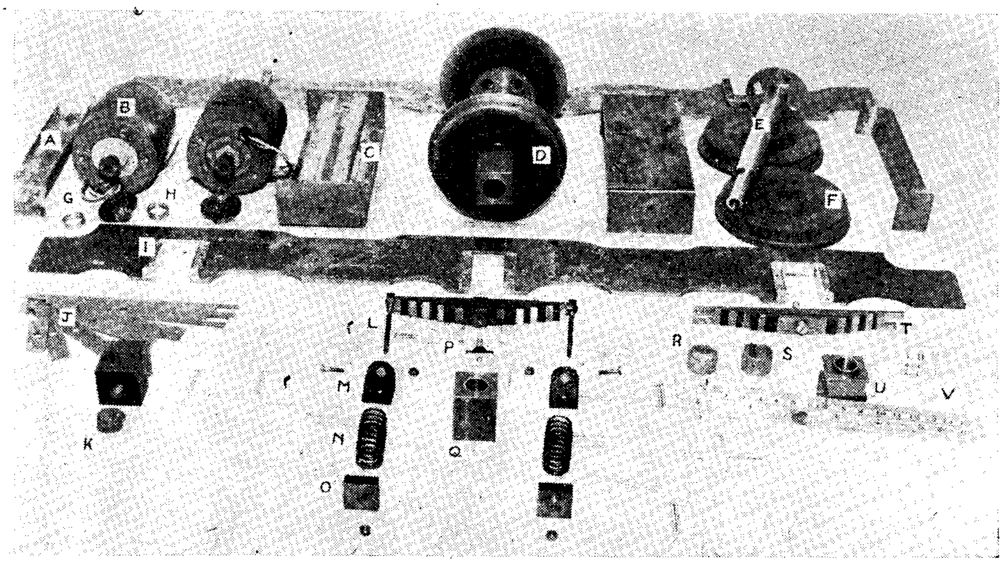


Photo by] [*M. H. C. Voake, M.P.S.*

A few parts for No. 2 bogie. " A "—end stretchers ; " B "—series motor. 24 V, A.M. Ref. No. 6BB/714 ex-Air Mileage Unit 6B/249 Mk. I ; " C "—main bolsters ; " D "—wheel-axle-gear assembly ; " E "—axle, fitted final drive gear ; " F "—wheels, rough turned ; " G " and " H "—intermediate gears and races (magneto type). Pinion steel, gear Tufnol ; " I "—side frames fitted temporary horns ; " J "—steel leaves, main spring ; " K "—felt lubrication pad for axleboxes ; " L "—completed reverse camber spring assembly ; " M "—hanger bracket ; " N "—auxiliary spring ; " O "—auxiliary spring bucket, counter-bored reverse side ; " P "—spring buckle pad ; " Q "—centre axlebox. P.B. bush flush, to allow side float of axle assembly ; " R " and " S "—P.B. axle mounting sleeves ; " T "—partly-finished main spring, showing Paxolin anti-friction interleaves ; " U "—end axlebox. P.B. bush projecting ; " V "—experimental air brake cylinder

the club track. This is quite a good idea ; instead of the batteries lasting perhaps two hours, we can go direct from the mains or a petrol generator at the trackside. When I say direct from mains of course, this wouldn't be allowed, but to step down to 50 V a.c. on live rail, up inside locomotive to 200 V and either use a.c. raw or rectify and float batteries across.

Another idea is to make a mock diesel generator unit, really a petrol engine and generator, a good bus type, and stick that inside the locomotive. There's no limit ! All good clean fun. To those who might accuse us of being concerned too much with power output, may we suggest that something must take the place of water vapour worship !

Seriously though, may I add my pleas to previous correspondents, who, in the immediate post-war period tried to foster interest in the model passenger-hauling electric locomotive. I know of one or two, notably Mr. Way, who have tried it out successfully, and Mr. Eden ; but we are apparently only a handful. Perhaps there is another " Milliamp " among us who can write a completed constructional series, or is there no demand ?

Think of the experimental possibilities of the electric job, especially for the multi-motored type. One can fiddle with the wirings and voltages without putting the locomotive out of commission—even the gear ratio can be altered on one bogie at a time, and you still have a running job. Further, even if, after hard collar work, a motor fails, the deletion and replacement is relatively simple ; whereas, if something blows up on a live steamer, it's usually had it for a thorough shopping.

In conclusion, I would invite criticism, suggestions or enquiries from interested readers re the above model and, indeed, on the whole subject of model electric traction in the larger scales.

Clearing Small Holes

Harold V. Eddy writes :—" A little idea has just occurred to me whilst cleaning the lathe : that is, the usefulness of a magnetised scriber for removing the small swarf that persists in getting into the lubrication holes of machine tools.

" It is also handy in cleaning the bottom of threaded stud-holes and other threaded blind-end holes.

" Actually, my scriber point became magnetised by accident, but one especially made up is well worth the trouble."

SMALL FLASH BOILERS

Philip M. Ward describes some aspects of their design

IT was with considerable interest that I read Mr. Pilliner's contribution in THE MODEL ENGINEER the other week, and especially his reference to the problem of improving heat transmission in flash boilers on model speed boats.

When designing a boiler for this purpose, the primary problem is to evaporate as large a quantity of water in as small and light a unit as possible. The question of thermal efficiency is generally neglected and is, in fact, often considered to be incompatible with the first two requirements.

radiates but little heat they utilise a luminous flame. Mr. Westbury, in his book *Flash Steam*, describes a burner for producing a flame of this sort, and by using this method greatly improved thermal efficiencies can be obtained. Unfortunately, a boiler working on this principle is, generally speaking, heavier and more bulky than the conventional "blowlamp" type, whilst the flame temperature being, of necessity, lower, much energy is wasted in the form of useless low-grade heat through the funnel.

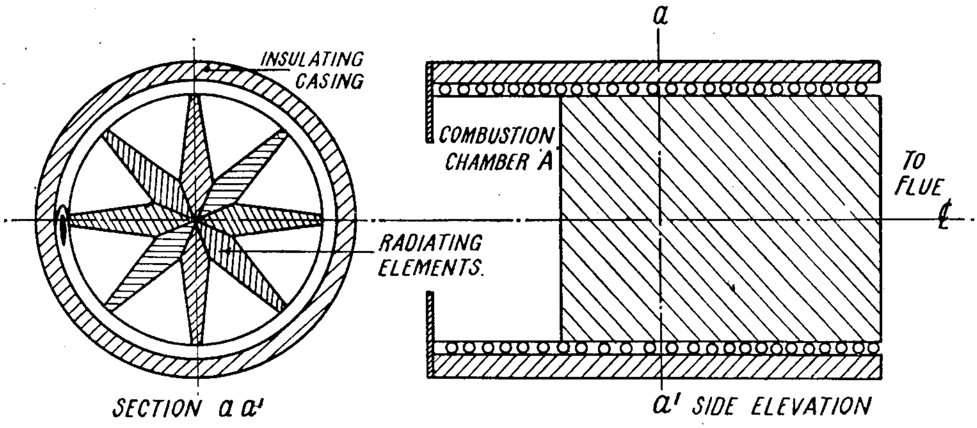


Diagram of radiant element flash boiler

I have been giving some thought to this problem over the past few months and have arrived at certain conclusions as a basis for experiment which I think might be of interest to other readers.

Most flash boiler plants for boat propulsion consist basically of a coil of tubing on which impinges a saturated flame from a vaporiser burner similar in design to a paraffin blowlamp, the whole operation of heat transference being conductive; from the hot gases to the water *via* the material of the heating surface. The temperature of the flame is very great, somewhere in the region of 2,000 deg. C., but unfortunately much of the available heat is unabsorbed, and the temperature outside the immediate combustion zone falls off very rapidly; the hot gases being diluted by cold air which is unavoidably drawn into the boiler round the sides of the nozzle. The designer is hence reduced to burning enormous quantities of fuel so that the boiler is a sort of inferno of flame, whilst only a very small percentage of the available heat is utilised.

The designers of modern steam cars have tackled the problem in a rather different way, their standard practice is to transfer heat by radiation without letting the flame touch the heating surface at all, and as an invisible flame

In industrial practice, too, every effort is made to use heat in the radiant form as being more readily available, and it appears that in model boilers this principle should be adhered to as much as possible.

In a visible flame the radiant energy is emitted by the small particles of unburnt carbon present which are raised to incandescence, and the fact that these particles are absent in a saturated flame accounts for the fact that no radiant heat is emitted from this source. We are, therefore, reduced to making use of a low temperature luminous flame.

Stephan-Bolzmann's Law for a so-called "black body" radiation ("so-called" because a "black body" can be practically any colour!) states that energy is emitted proportional to the fourth power of the temperature in degrees Kelvin, or more correctly :—

$E = \rho\ T^4$ (where ρ is Stephan's constant).

So it appears that if the flame temperature can be raised without any diminution of its radiant properties, the energy emitted in radiant form will be enormously increased and the boiler efficiency will hence be much improved.

This condition of increased temperature without reduction of radiation effects seems unattain-

able with a luminous flame, but there appears to me to be quite a satisfactory alternative. Why not raise a refractory surface to incandescence with a non-luminous, high temperature flame and absorb the resultant radiation in the normal way?

The ordinary gas fire makes use of this principle, and of the total available heat a very large quantity is radiated and only a little passes up the flue unused. Further, an element as used in a gas fire is comparatively light, and all that there seems necessary to do is to surround such an element with a closely wound spiral of tube, through which water is forced and evaporated.

Of course, I realise that the ordinary gas fire element is far from ideal for the purpose, being too narrow and of an unsatisfactory shape. In the diagram is shown a design for a boiler which I propose to make on this principle using a "star" section element. It will be seen that a small combustion chamber is provided at *A* to ensure that the mixture burns evenly in the isolated segments of the boiler. It is intended to raise projections on the fins of the element to promote a turbulent flow of the burning gases.

I am at the moment rather at a loss to find some suitable compound for making an element which is both light and resistant to high temperatures, but think that some sort of asbestos paste might do. Perhaps readers could suggest something satisfactory.

The burner used could be either of the blow-lamp type or of the carburettor type described by Mr. Westbury. I think the latter would be more satisfactory, as with this type the quantity of cold air entering the boiler can be limited to that necessary for complete combustion of the fuel.

I only hope that this article has proved of interest to "flash steamers." If my theory is vindicated by experiment, it should be possible to produce a boiler which, besides being more efficient, is actually lighter and more compact than a conventional boiler of similar capacity, and then, who knows, perhaps we shall see flash steamers beating the i.c. buzz-boxes every time!

Plastic Materials for the Engineer

by R. Robert

WITH the supply of both steel and non-ferrous metals becoming ever shorter as the rearmament programme develops, model engineers will again be looking round for substitutes—and fortunately some are to hand with possibilities still largely unexploited.

For convenience sake, plastics may be divided into two main categories: (a) thermo-plastics, and (b) thermo-setting plastics. The former, after having been moulded into shape, can, by the application of heat, be softened and remoulded again any number of times. The latter can only be moulded once, in the first stage, and when finished, in the "cured" condition, cannot be resoftened.

The way in which plastic materials, which include the cellulose compounds, casein, vinyl resins and synthetic rubber, can be used as substitute metals is almost infinite. One may single out, for example, gears—which play such a vital part in almost every mechanical device.

Gears of all sizes, from those used in clocks to heavy machine-gears up to 5 ft. in diameter, and all types, spur, bevel and helical, are available in plastic materials, and give complete satisfaction. For certain purposes it may, in fact, be asserted that the plastic gears offer many advantages over the metal ones, such as greater strength in relation to weight, superior resilience and ability to absorb sudden strains and shocks. Most important, however, is the fact that the plastic gears need no lubrication, and are completely silent in operation.

Not only gears, but machine bearings are available in plastics, made from the same material, i.e., laminations of fabric, or asbestos, impregnated with resin and compressed under heat. The plastic bearing, too, offers certain advantages. No lubricant is required, though under practical conditions it is usual to use water, which serves the further purpose of keeping the bearing cool. Frictional losses are reduced to a minimum, and are less than a third those of a white metal bearing of the usual type.

Anyone in charge of an engineering workshop, small or large, will have come face to face recently with the shortage of sheet steel—this despite the coming into operation of new rolling mills in South Wales, and will have been forced to consider possible alternatives. As it happens, here also plastics can be utilised to relieve the situation.

Some of the sheet-plastics developed and placed upon the market will stand up to the most exacting tests. Not only are some of them resistant to moisture to a very high degree, but they are able to cope with wide temperature fluctuations, and are extremely resilient. Many industries are already placing great reliance on them, including the aircraft industry.

A final point, not without its relevance and importance, is that both the thermo-plastic and thermo-setting materials can be machined, drilled, cut and filed in much the same way that metals can, some, of course, being easier to handle than others.

TWIN SISTERS

by J. I. Austen-Walton

Two 5-in. gauge locomotives, exactly alike externally but very different internally

WHILST working one day, my thoughts turned to "Minor," and the problem of specifying what to do and what not to do in order to make it comply with the original ideal. I turned up copy No. 1, just to make sure what I *had* said, and when I found it, not much help came from it. In every instalment we are told that we are building "two locomotives, exactly alike externally, but very different internally"; that word "internally" stuck in my mind quite firmly and seemed to convey little else than the boiler.

Even the word "externally" began to trouble me, and being able to remember all the simplifications I had offered or suggested to readers from time to time, it was obvious that already it was possible for the external appearances to have become altered.

You cannot put two engines side by side—one with fluted motion work, and the other without such a refinement, and not notice the difference, and the changes do not stop here, as we know.

It is so easy to be wise after the event, and to make the excuse that "a generally simplified" engine was the original intention; in fact, this *was* the whole purpose of "Minor," namely, to give you an *unspoiled* engine, having roughly the same performance as "Major" and not too much trouble with the machining of the various parts.

Even now I am not suggesting that we have failed in our mission, but that from henceforth we have got to be very careful to keep the general balance of things just right, not only from the point of view of appearances themselves but also from the working aspect.

Let us consider a few details; the engine is quite a "plain Jane," in that it has no outstanding frills and flounces, and which is the state of affairs one would expect with a hard-working yard engine. This does not imply that the little lady is lacking in a more natural or functional form of beauty, at least, not to my mind and eye. If I wanted to get a bit nasty about looks alone, I would point the accusing finger at some of the later streamlined horrors which, although they satisfy the younger generation with the suggestion of sheer, sleek speed, may not (and in some cases, do not) live up to their creators' dream of perfection.

Our particular problem is different; here we have a perfectly well-designed locomotive, and we do not want to spoil her balance in any way. As she is in the prototype form, so she must be in miniature, but she must also be drivable and efficient.

Looking at both "Major" and "Minor" we find we have cylinders of equal bore and stroke that will require the same amount of steam to operate them satisfactorily—no differences to be found here at all, and that, straight away, means the same or similar boiler. How similar?

There is no earthly reason why the externals should not be identical, and I have already taken it for granted that the shell would accommodate quite a number of variations in the sizes and nest arrangements of tubes, and, whatever arrangement I offer you eventually, there is bound to be at least one school of thought that will condemn it straight away.

I have reasons for thinking such things ahead, for as the boiler drawing is completed in the rough, as it had to be for me to build the boiler, it was also available to one or two close friends who wanted a preliminary look into the future. I do not know just how many such friends have taken advantage of this service—quite a few, in fact, and all have given me interest in their reactions to a fairly new design, or perhaps I should say—a new method of construction. By and large, they accept in stages from complete agreement to great enthusiasm, which is a promising start. *All* of them have seen the boiler, and a couple were in my workshop when the boiler was tested; one of these gentlemen, who had never before seen a hydraulic test, was given the job of working the pump while I snooped around looking for possible leaks. "Keep the needle about 275 lb." I told him, but his interest in my department took charge of the situation, and when I looked round, the needle was somewhere about 320 lb.; he had not realised that a single stroke of the pump handle would make all this difference.

As the boiler would stand about 500 lb. with ease, it did not matter in the least, and nothing was said about the incident. But to come back once more, one friend who had seen everything and was apparently satisfied, borrowed the drawing to study. When later it was returned, he told me that he was going to modify the tube arrangement to suit his own particular fancy, and mentioned the alteration he had in mind. In this particular case I do not suppose the steaming characteristics of the boiler would be much altered, but it made me wonder what would happen if other builders decided to "re-design" the interior parts, and what would be my position in the event of the boiler failing to come up to scratch.

I think I ought to state, here and now, that builders are at liberty to build what they like. If they build a better steaming boiler than mine, then the facts should be made known, and I would assist in bringing to notice the improvements made. If, on the other hand, the experiment did not produce such happy results, then I consider the builder should let it be known that

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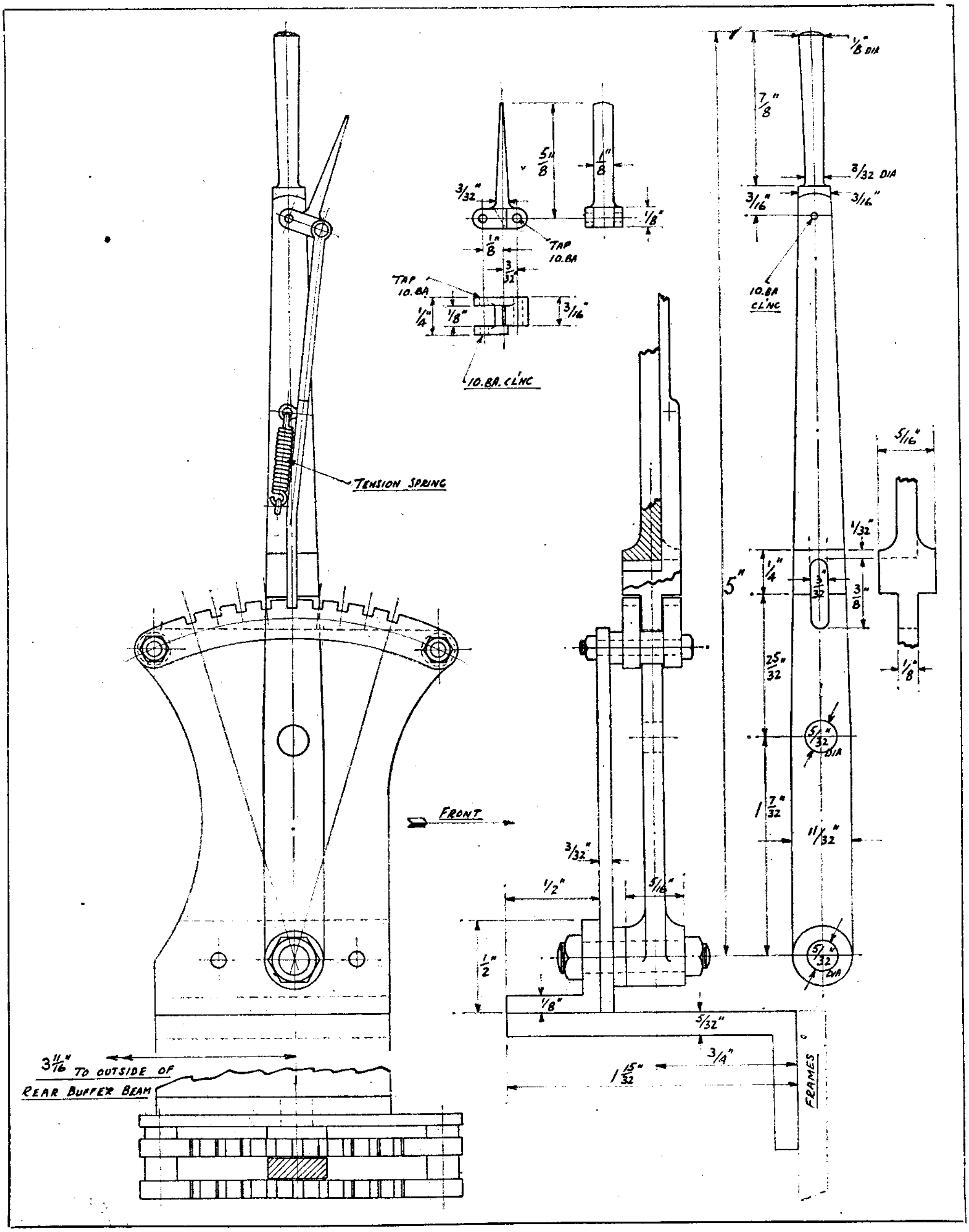
Continued from page 295, "*M.E.*," *August* 28, 1952.



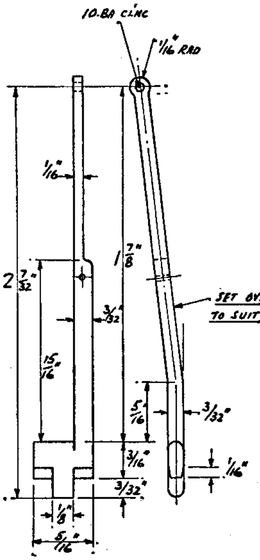
the engine was not the true version of the " Twin Sister " as described.

The difficulty is that it will be so very hard to find out the *relative* advantages or disadvantages of the alternative types ; a good driver with a bad boiler may be able to put up as good a performance as a bad driver with a good boiler, or the boiler may be good and the engine only indifferently made. It is all very complicated, and I do not think anyone has yet produced a method or formula that covers not only the engine and boiler, but the driver as well ; all we want now is some smart Alec to bring up the question of types and grades of coal, to start a full scale argument. I think this all boils down to a simple statement; it is, "If you build the engine properly, and do not mess about with the design, it will work very well indeed."

The Reversing Lever

Commonly known as the "pole reverse," this rather important item, drawn with especial care and modelled exactly on the prototype, I give you now.

All the external and visual details are *exact*, and you have here an almost perfect little piece



of machinery to create. Levers are important things, and apart from anything else, I like to handle them. If the lever is right, it will *feel* right—this one does, because I have made it and found out for myself.

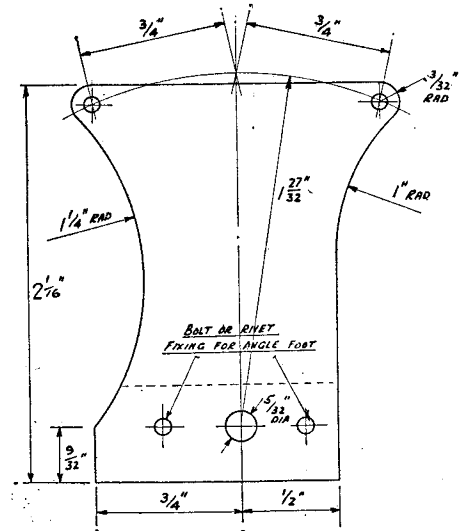
Everything can be stainless-steel if you can get the material—even the tiny spring, and then no harm in the form of rust or tarnish can ever spoil its beauty, which, as I have said before, is why I like the steel so well. Let us consider some of the points of actual making.

The stand and sectors are just pieces of stainless plate, cut out to the shape given. The notches in the sectors should not be cut right away, but kept plain until the whole thing is set up on the frames to check up with the reach-rod length, and the required movements in both directions. The lever will require the most care, and if you look carefully at the drawing—side section especially—you will see that it has three enlarged portions, one at the top for the handle itself, one about the middle where the catch is housed, and one at the bottom, forming the main fulcrum eye. I made my lever from one chunk of stainless-steel, which was a flat section to start with, and parts were first milled away with an end-mill having a radius end. With the work still on the machine, this end-mill was substituted for a normal type of end-mill, so that I could reach the sharp corners. At the place where the handle was going to be, a blob was left, and a smaller blob at the bottom for the eye.

My original intention was to centre these two blobs which, incidentally, had some spare length so that the final centres could be cut off, and to turn the handle *in situ*. This method failed miserably, as I found that the unequal section of 11/32 in. by $\frac{1}{8}$ in. whipped in a rather disconcerting fashion over such a comparatively long, unsupported span. The trouble was overcome by setting the blade in the four-jaw chuck, right close to the handle blob, making use still of the centre provided whilst the rough metal was removed, and cutting off the end to length only for the finishing processes.

The blob at the bottom end was made a hand job entirely, and it did not take long either. The lever was now set up again for the purpose of milling out the through slot for the catch, and in quite another sense, this is where the catch is. If the steel to be used for the catch is exactly 3/32 in. thick (and it is *bound* to be, out of sheer cussedness) then it is no good trying to cut the slot with a 3/32-in. end-mill. I know it *sounds* difficult, but the remedy is to stone down a 3/32 in. to the size required ; do this with a small, flat slip stone, soaked in paraffin, using a good light and taking plenty of time to do it. By keeping the cuts very light and chasing up and down the slot very frequently, the final ugly gash in that beautiful piece of steel should be very nearly, if not exactly, to size.

In the event of too much slack being present when the catch is set up, here is a good dodge to put things right, and even *improve* the working surfaces thereby. Put a fairly heavy coat of silver-solder on both faces of the catch, and file away to fit ; this coating also serves another good purpose, in that it prevents similar metals coming into rubbing contact. Always remember



this excuse when some busybody finds faults with work you have "corrected"—there is no answer to this one.

The Approach of Spring

There is nothing like making an artistic approach to a delicate thing like a spring. Somebody is bound to want exact details as to gauge of wire used, compressed or free length, poundage

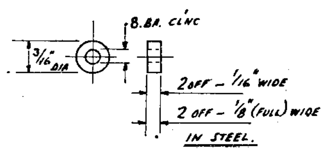
required to extend said spring " X " inches, at normal atmospheric temperature and pressure, and so on. That department is three floors up, and I'm busy down here at the moment; but if you really want to make a spring, all you need is some fairly fine spring wire, a stouter piece of wire or the shank of a small twist-drill on which to wind it, and a keen ear for music; the latter accomplishment is useful the first time the spring gets away, and you want to hear where it lands. A lost spring has also been responsible, more than once, for a really thorough clear up in the workshop; but that, of course, is the purely human angle and I will not pursue it further.

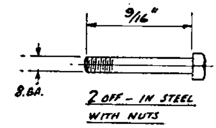
Come in, " Minor "

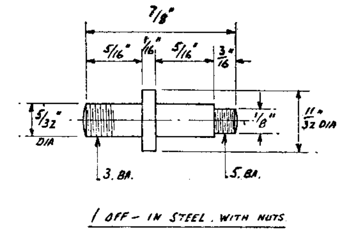
" Minor " has been in the news so much during this instalment, that we must not fail him now. When he comes to make the lever part, he may prefer to start off with a plain blade of $\frac{1}{8}$ in. material, and stick all the other parts on.

If he can guarantee to silver-solder *well*, he may be permitted to fit the handle portion on in this manner; but nothing looks sillier than a handle that falls off at the first important locomotive meeting, so rather than face such a degrading debacle, he may have second thoughts and finish off the blade with a small portion of male thread to which he may screw the handle securely.

The other portions simply call out for building up with silver-soldered additions, with the bottom eye built up with turned bushes, " let in " to a larger hole, and the soldering metal run round the lot; this is similar to the methods I have described before, for use on cranks with wide bosses.







Setting Up the Lever

The position for the lever is given, relative to the rear buffer beam, and its vertical position is shown on the drawing as level with the frame line at that point. It is necessary to make up a reach-rod—not shown on the drawing; this is simply a strip of metal, $\frac{1}{8}$ in. thick if in ordinary mild-steel, and 3/32 in. thick if in stainless. The rod can taper from about $\frac{7}{16}$ in. wide at the lever end, to about $\frac{5}{16}$ in. at the crank end, and it will have to be set to pass the side of the firebox. This is not as difficult as it may seem; all you have to do is to avoid the opening provided for the firebox (the space between the last two stretchers, in case you do not know by now) at *all positions of the lever.*

When making the sets in the reach-rod, keep these long, gentle and sweeping, within the limits and conditions as set forth above; a rod treated in this way, looks better and is much stronger and stiffer than one having short sharp bends.

(*To be continued*)

A Control Lever for the " Busy Bee "

(*Continued from page* 408)

at *B*. These operations are quite easy with new cable, but on a repair job, it may not be found at all easy to get the solder to adhere properly to greasy or dirty cable; however, this is most essential if the soldered joint is to be really secure.

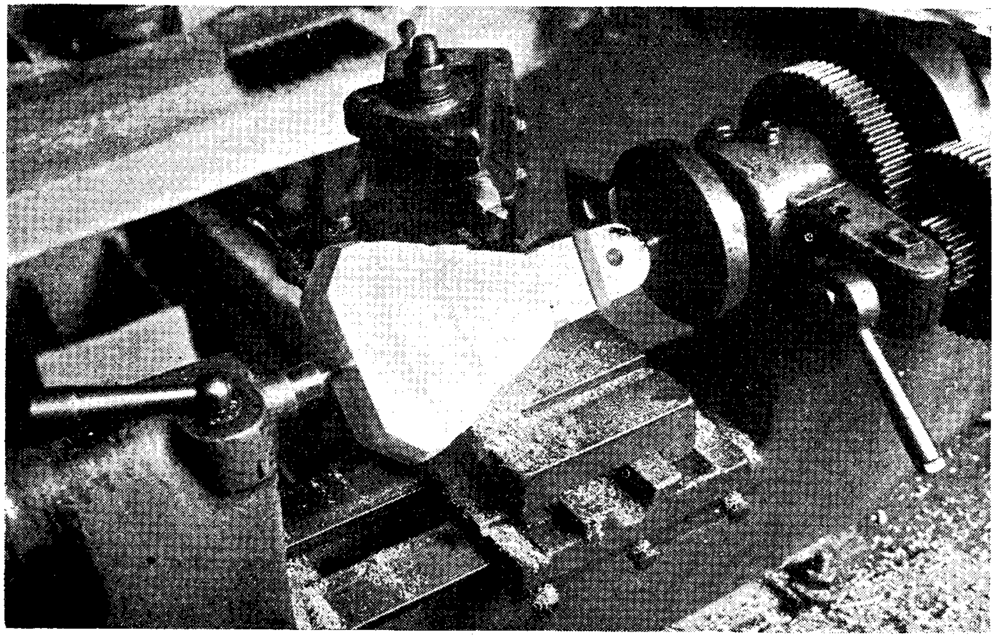
The cables should be attached at the engine end, that is, to the carburettor and decompressor, before attaching the nipples in the control lever. In the case of the carburettor nipple, this is necessarily very small, and in the form of a ferrule or bead. Sometimes this is made by winding a few turns of fine copper wire round the cable and soldering it into a solid knob, and this is quite satisfactory if properly done, but I prefer to make a solid nipple from brass rod and secure it as described.

After securing one end of each cable, the outer casings are threaded over them, with thimbles on the ends to protect them where fitted to the sockets. The amount of spare inner cable required at the control end, with the throttle and decompressor both closed, is measured, allowing for the thimbles to be seated in the sockets *at both ends*, and the control-end nipples can then be sweated on. The cable adjusters should, of course, be screwed right in, so that any subsequent stretch can be adjusted to the maximum extent. By removing the cover plate, spring washer, thrust washer and upper keep plate of the control, the nipples may be fitted in place and the parts reasssembled. The casings are then sprung into the sockets, and all that remains to be done is to adjust the cover plate to provide sufficient friction for comfortable and positive action of both controls.

A TWIST DRILL POINT GRINDING JIG

by W. D. ARNOT

THE swing block has been left attached to the tooling centre-piece, and before that is cut off, the scribed centre-line is carried through down the ends, and these are centred with a centre drill for mounting between centres or, if a four-jaw independent chuck is available, only one end requires centring. The wide end of the block is faced and the corner bevel machined to prevent obstruction of the cam counter-thrust pillar



Photograph No. 6. Set-up for end-facing

on the base. (Photograph No. 6.) The bore can now be drilled through the block. Having drilled it ⅜ in., I finished with a boring tool to give a good fit on the chuck arbor previously prepared. Photograph No. 7 shows this stage of the work. When a satisfactory bore has been finished, the tooling-piece may be sawn off and the other face of the block machined square and to such a length that it will allow the chuck jaw nose, with chuck closed, to come some 1/32 in. behind the centre of swing. I found it convenient to grip a piece of ½ in. bright mild-steel in the self-centring chuck and push the block on to it. The unorthodox driver was a piece of rope tied round the block in the grooves and passed back round the chuck body and tied there. (Be sure no loose end is left to fly around.)

Continued from page 379, " M.E.," September 18, 1952.

Chuck Arbor

This is a piece of ½ in. bright mild-steel drilled through 7/32 in., given a Morse taper nose to fit the Jacobs chuck, and the chuck driven firmly on it, with a careful check for true running.

The Base

We can now prepare for a trial assembly. Clean up the 10-deg. bosses on the base and check them level across centres with a spirit-level, by scribing block and feelers or with dial test indicator. Great precision is, of course, not called for. Mark off the centres to be drilled from one of the finished sectors. I found it convenient to clamp the lot—base, bottom and top sectors—together with a wood wedge cut to give a parallel clamping surface. The holes through both sectors then gave some indication, by their depth, of square setting under the drill. The bolts will be 3½ in. × ⅜ in. B.S.F., the tapping size for which is letter " O " (0.316 in.) ; a $\frac{5}{16}$ in. drill will do (0.3125 in.). Drill the base bosses and tap through.

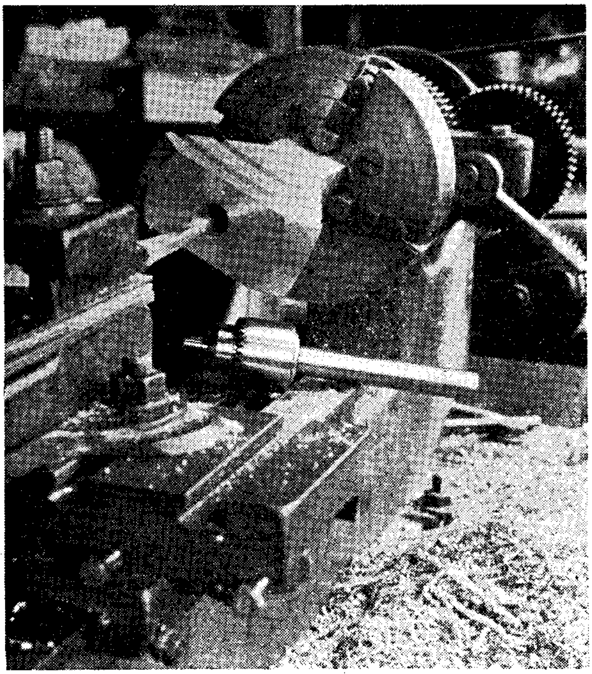
Bolts

Commercial bright mild-steel bolts 3½ in. × ⅜ in. B.S.F. were obtained, but these are usually screwed only some 2½ in. diameters up the shank so that the thread has to be carried further,

to within about 1½ in. of the head. I found the correct die but no stock to fit it. A three-jaw chuck did service as a substitute and the bolt was screwed into the die using a spanner on the head. Unorthodox and judged not to make a perfect thread, but there was nothing wrong about its true running and appearance.

Trial Assembly

All is now ready for a trial of the movement assembly. The grooves have been machined to take ¼ in. steel balls and two are used in each groove, top and bottom, i.e. eight in all. Drop them in about ½ in. from each groove end on the bottom sector, position the block, add four balls and the top sector ; position over the base tappings and pass the bolts through with a few washers under their heads. Screw down to just hold the balls. A free movement should be felt for the short stroke the block makes ; about ⅜ in. If all is well, a check is made to see if there is enough thread for a nut above the bottom sector. Cut the thread to allow this. The ⅜ in. nuts are reduced on the flats to the size of a ¼ in. nut and a taper chamfer cut on them to allow maximum swing room. Also, to clear these nuts, the swing block is marked for their contact position and a half-round clearance is filed in the lower edge of the block either end at the angle of the nut chamfer.



Photograph No. 7. *The boring set-up*

Ball Retainers

Plates are now marked out to fold over the end edges of the swing block and for clearance slots around the ball positions, elongated the length of their rolling travel theoretically half the swing travel ; practically about ½ in. centres. I found handy some 21-gauge aluminium sheet but there is ample room for thicker material. The plates and nuts prepared, a second assembly is tried, the chuck and arbor put in place, and we are now ready to tackle the operating control members.

The Cam

This is the first item that slides on the chuck arbor behind the swing block. It is a $\frac{5}{16}$ in. thick disc of 1¾ in. diameter shafting, bored to fit the arbor. The face is scribed into four sectors. The lowest point of the cam will touch a 1 in. diameter circle, giving a rise of ⅜ in. to the outside diameter. An arc is struck to join these points over one sector, i.e. a quarter turn. File to shape and polish. Before the cam is drilled for the locating pin, it is best to make the locking collar so as to drill the two together. (Fig. 9.)

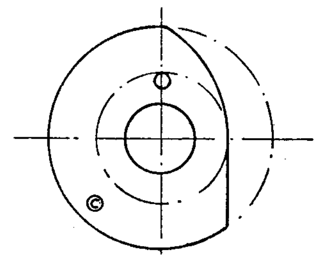


Fig. 9. Cam

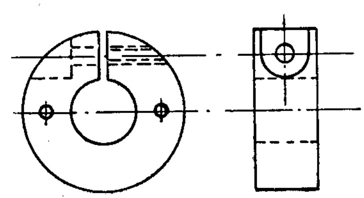


Fig. 10. Locking collar

Locking Collar

A ½ in. thickness of 1¼ in. shafting does well. It is bored, edge recessed with a ⅜ in. end-mill for the clamping-screw and sawn through one side below the recess. A cheese-head screw is used. Mark out for cam lock drillings dead opposite on diameter. (Fig. 10.)

Operating Wheel

The knurled operating wheel is a slice of 1¾ in. shafting, drilled centrally to take a ⅜ in. bolt

which is turned down beyond the required thread and then stepped again to enter the arbor bore a nice push fit. To one side of the bolt a pin is screwed in to register with the turn-over drillings in the locking collar ; this is also stepped down to enter them push fit, and should be long enough just not to pass through the corresponding single hole in the cam. When turning over, the assembly is withdrawn enough to clear the cam, the cam is held, the locking collar with arbor turned 180 deg. and the drive assembly fully withdrawn and entered in the new position of register with the cam hole.

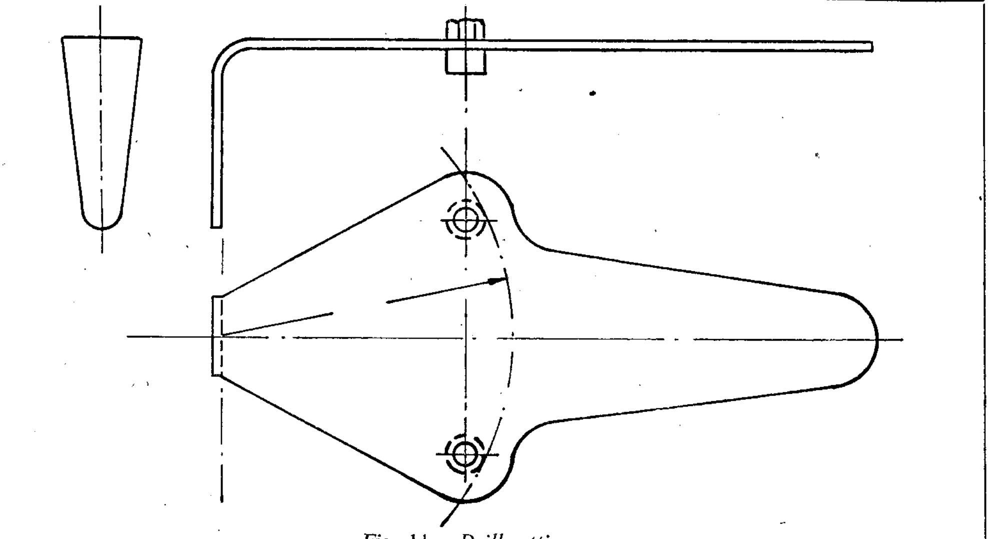


Fig. 11. Drill-setting gauge

Cam Counter-thrust Pillar

To allow latitude in adjustment, the simple standard with peg has been made with adjustable head, the conical standard finishes at the top $\frac{5}{16}$ in. parallel. To that portion is fixed a short piece of $\frac{1}{2}$ in. round, cross drilled $\frac{5}{16}$ in. one way and $\frac{1}{4}$ in. at right-angles, with a slot between. In the slot is a shaped block part enveloping the $\frac{5}{16}$ in. standard and the $\frac{1}{4}$ in. roller carrier. An Allen screw passing in endways draws the whole up solid. The unit may be swung, raised and lowered. The small roller against the cam is a refinement not imperative, but it helps sensitivity.

Return Spring

This is quite weak ; it will not support the weight of the swing block assembly if the jig is turned on its side. A $\frac{1}{4}$ in. diameter close-coiled spring was used, one end secured to the corner of the swing block and the other to the top sector. There it is quite unobtrusive yet handy to mount.

Withdrawal Spring

It is an advantage to provide a light spring between the cam and the face of the swing block ; it prevents the inadvertent excess feed when grinding that tends to occur with drills so fine that contact with the wheel is scarcely discernible.

Feed-limiting Screw

This was thought undesirable but found in practice to give easier control. It was tapped $\frac{1}{8}$ in. through the surplus edge of the cam, to bear on the face of the swing block. A brass cap fits loosely on it to slide against the swing block end face. When grinding, the screw is withdrawn just to allow wheel contact and then a fraction of a turn more to limit the cut that can be applied.

Setting the Drill for Grinding

Horizontal setting of the first cutting lip is by sighting. Forward position is critical, as the tip must stand on the centre of the swing circle. Fig. 11 shows a plate gauge made to determine end position. Two screw heads bear against the upper sector forward edge when the down-bent limb gives the face which the drill must touch.

Operation

In working the jig, the knurled wheel is pushed and turned, allowing the cam to push the block aside. Immediately the cam crest is reached, the withdrawal spring is allowed to return the drill clear of cut ; the block can then swing back.

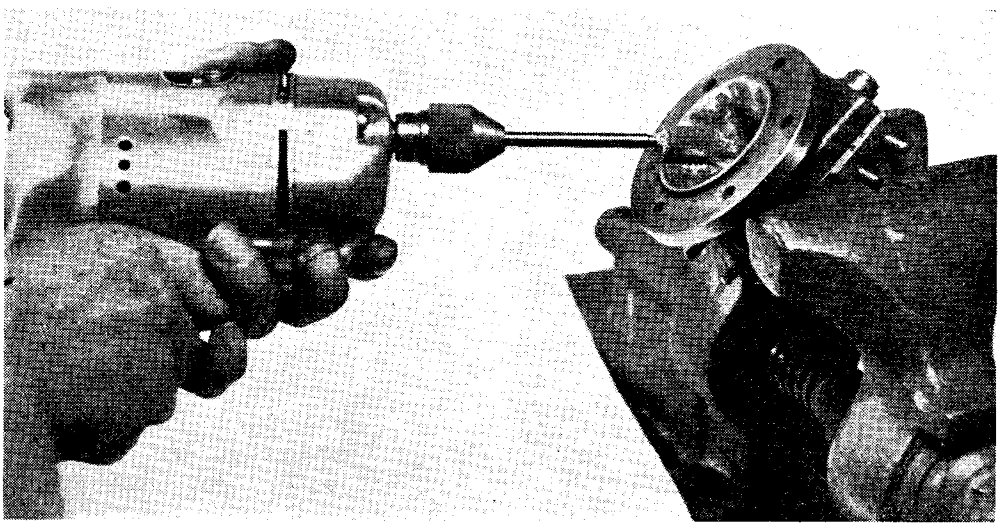
Setting the Jig

The front edge of the base casting is at 118 deg. included angle. The appropriate edge of that angle is set in line with the side face of the wheel and if a drill has been fitted to the gauge, it should just touch the wheel. Facings have been provided on the base casting which may be drilled for fastening down, and once correct setting has been determined, the holding-down arrangements need not be disturbed, but remain to give future automatic setting.

The "Handy-Utility" Abrasive and Polishing Kits

AMONG the latest additions to the range of accessories for the "Handy-Utility" power tool, which was reviewed in these columns some time ago, is a kit of abrasive rotary tools suitable for working on surfaces which are not accessible to ordinary grinding wheels or buffs. These are all arranged to work on arbors ¼ in. diameter, which can be held in the ordinary drill chuck, and consist of strips of abrasive-coated fabric rolled into cylinders of various diameters and cemented. In the smaller sizes, these are arranged to fit a taper-screwed arbor, but the larger sizes are mounted in an ingenious manner by means of expansible rubber bushes on shouldered arbors, having screwed ends with nuts and washers fitted. When the nut is screwed up to compress the rubber endwise, it is forced outwards so as to grip the inside of the abrasive cylinder firmly but flexibly. Both fine and coarse abrasive cylinders are provided, and can be changed in a few seconds.

The kit comprises four abrasive cylinders 1 in. dia. by 1 in. long, four ditto ¾ in. dia. by ¾ in. long, and four ditto ½ in. dia. by ½ in. long, for mounting on rubber arbors; two small cylindrical and one conical tool for taper-screw mounting, and four arbors. We have found these tools extremely useful for such purposes as smoothing and polishing the cylinder-heads and ports of i.c. engines, also external or internal work on castings which cannot readily be machined. They can, if desired, be used in the lathe or other machine tools, but for maximum durability and efficiency, must be run at the normal speed of the "Handy-Utility" power tool. It should be noted that they are not claimed to be suitable for precision internal grinding, lapping or honing of cylinders, in which dimensional and circular accuracy is required in addition to surface finish.



Using the "Handy-Utility" drill and abrasive tool for polishing the inside of a cylinder-head

For dealing with larger surfaces, the "Handy-Utility" Buffing Kit is recommended. This comprises a 3 in. cotton buffing wheel, a 4 in. wire scratch-brush, and a 3 in. general-purpose grinding wheel, all having a ½ in. centre hole to fit the arbor provided, which has a ¼ in. shank to fit the drill chuck; also, a tube of polishing and buffing compound. This outfit is suitable for a wide range of operations, including cleaning, burnishing, removing scale or paint from metal surfaces, or sharpening cutlery or edge tools.

Other accessories, which are obtainable separately, include 5 in. lambswool mops for producing a superfine finish on cars or polished woodwork in conjunction with wax or other polishing compounds; and 5 in. diameter sanding discs in coarse, medium and fine grades. These tools are designed to be mounted on a 5 in. diameter moulded rubber pad, with a ¼ in. shank to fit the drill chuck, and are attached by means of a clamp washer and screw, which are recessed so as to be well clear when working on flat surfaces.

"Handy-Utility" tools and accessories are manufactured by Messrs. Black & Decker Ltd., Harmondsworth, Middlesex, and obtainable from tool dealers everywhere in Great Britain.

CLAMPING-BOLTS AND CLAMP HANDLES

CLAMPING-BOLTS are fitted in many places to machine tools for the purpose of securing components after they have been set in position.

A familiar example is the clamp-bolt used for locking a four-station tool turret on its base. For convenient and safe working, the locking handle, when fully tightened, is set to project towards the tailstock, so that it is kept well clear of the chuck jaws and can be safely operated with the right hand even when the lathe is in motion. If the locking handle screws on to a

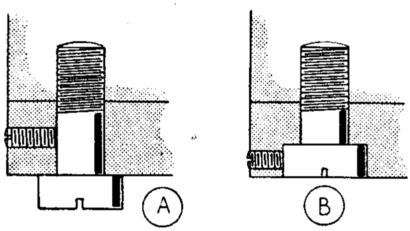


Fig. 1. "A"—projecting bolt-head secured with set-screw; "B"—recessed bolt-head

stud, the position of the lever will not alter when the stud is screwed further into the base of the turret.

The necessary adjustment can, however, be made either by machining the abutment face of the lever or by placing a washer of the requisite thickness between the clamping surfaces.

Nevertheless, as wear takes place, the position of the lever will alter and further adjustment may then be necessary.

An exact adjustment can, however, be easily made at any time if the clamp-bolt has a plain shank; the bolt itself is turned and then locked after the correct setting has been obtained.

A few of the various ways of locking a clamp-bolt are illustrated in Figs. 1 and 2. In short, either a grub-screw or an Allen screw can be fitted to bear against the bolt-head or shank, and a screwdriver slot or spanner flats are provided for setting the bolt. Where a hexagon-headed bolt is used, only six positions will be available, but these can be increased by fitting a bolt with a scalloped head located by a set-screw.

Clamp Levers

For occasional use, a hexagon nut will serve for securing a clamp-bolt, but machine tools are usually fitted with clamp levers to enable all operating adjustments to be made with the hand alone in order to save working time.

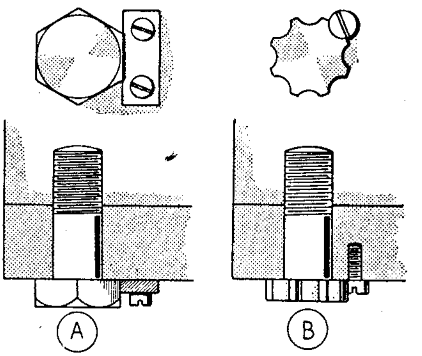


Fig. 2. "A"—locking plate for hexagon bolt; "B"—bolt-head locked with set-screw

The usual form of clamp lever has a ball at either end, and one ball, after being machined to form the abutment face, is drilled and tapped at an angle to give a more convenient working position.

Clamp levers of this pattern may take some time to make, but there are others which are easily made and are fully effective, as well as having a good appearance.

The simple clamp lever illustrated in Fig. 3A and Fig. 4 consists of a threaded collar, forming the nut portion, and a handle screwed into

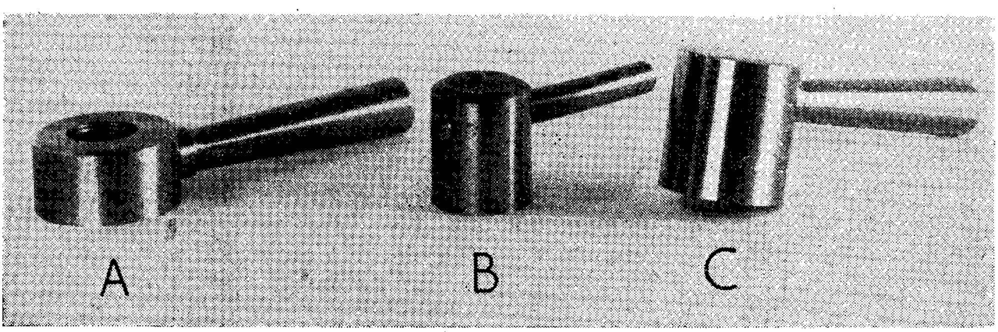


Fig. 3. "A"—open-ended clamp lever; "B"—cap-nut with through handle; "C"—cap-nut with threaded handle

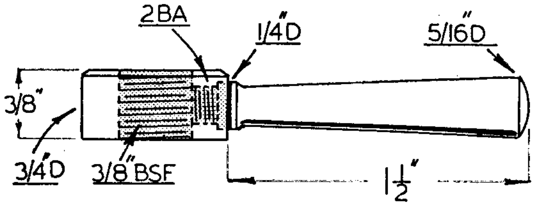


Fig. 4. Details of clamp lever in Fig. 3A

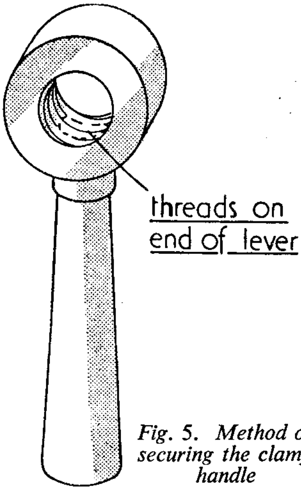


Fig. 5. Method of securing the clamp handle

place. The collar can be drilled and tapped in the lathe before being parted off to length. The work is, next, gripped in the machine vice for drilling the radial hole to tapping size ; this hole is opened out to receive the end of the handle, so as to form an abutment surface and also to mask the screw threads. When machining the handle, the end is first shouldered down and then threaded, a centre is also formed with a

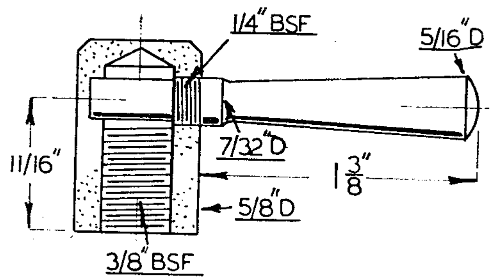


Fig. 6. Details of clamp lever in Fig. 3C

centre drill. Next, the rod is drawn out farther from the chuck and the tailstock centre is engaged. After the topslide has been set over to an angle of about 1 deg., the taper is turned by hand feeding, with the lathe running at high speed in order to obtain a good finish. The taper can be polished with a well-oiled strip of emery-cloth ; the oil not only helps the polishing, but it also keeps any abrasive from falling on to the lathe. When the handle is screwed firmly into place, its internal end should come level with the crests of the nut threads. If the tap is now again put through the collar, the end of the handle will be threaded, as shown in Fig. 5, and, once the lever is in place on its bolt, the handle cannot unscrew.

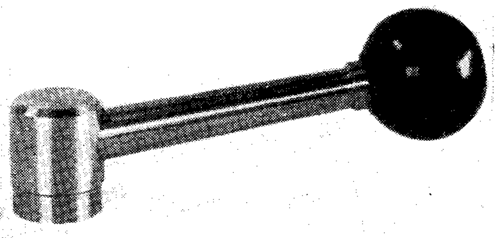


Fig. 7. Drilling-machine clamp lever with detachable parts

The small clamp lever shown in Fig. 3B is made in the form of a cap-nut, with the handle lying above the screw threads and pressed into place in a hole drilled right across the nut.

The handle can either be made from a length

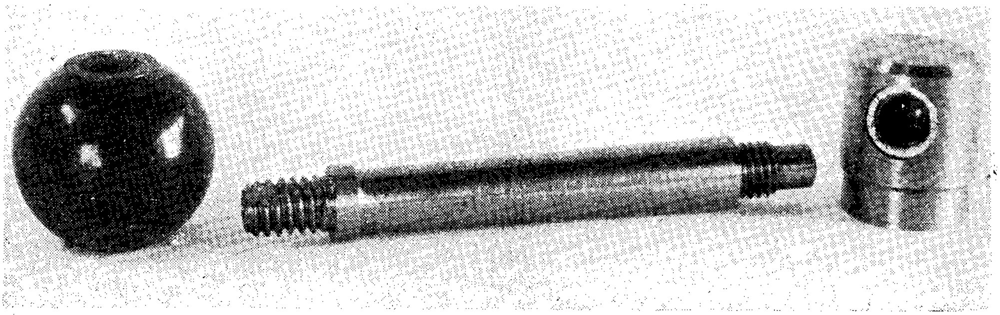


Fig. 8. Components of the drilling-machine clamp lever

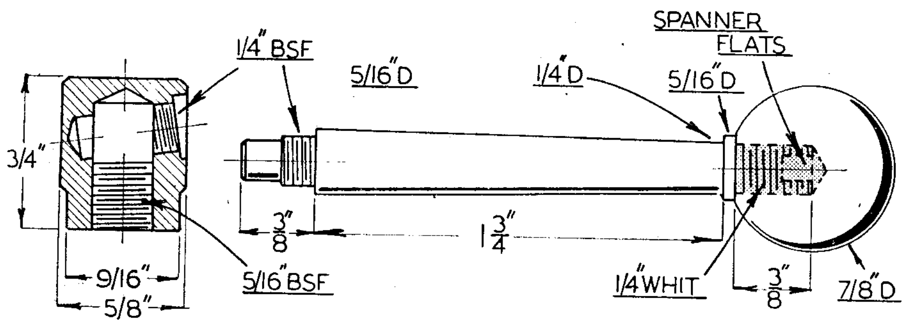


Fig. 9. Constructional details of the drilling-machine clamp lever

of parallel rod, or a large taper pin will sometimes serve.

However, the appearance will be more workmanlike if the lever is fitted to the cap-nut in the way illustrated in Fig. 3c and Fig. 6. Here, the handle screws into the nut and, when fully tightened, its further end bears against the bottom of the cross-drilled tapping hole.

It sometimes happens that the design of the machine parts does not allow the clamp lever to make a full turn, and it cannot, therefore, be screwed directly into place on its bolt. Nevertheless, it is sometimes, but not always possible, to engage the clamp lever by rotating the bolt. A case in point cropped up when building a drilling machine from castings. The table clamp-bolt had a square head abutting against a flat face to prevent rotation, and the clamp handle fouled the table when making more than a partial turn. This difficulty was overcome by making the clamp handle detachable, so that the nut could be screwed home and the handle afterwards fitted. The finished lever is shown in Fig. 7, and the method of construction is illustrated in Figs. 8 and 9. As will be seen, the design is similar to that of the previous example but the handle is set at an angle for convenience of working, and two spanner flats are formed on the end of the lever so that it can be readily assembled after the nut has been adjusted.

Although the square-headed bolt will provide alternative positions for the clamp lever, it may happen that none of these is correct ; if so, a fine adjustment is made by taking a facing cut in the lathe over the abutment surface of the nut.

Isle of Wight Exhibition

THE 1952 exhibition of the Isle of Wight Model Engineering Society was recently held at Ryde, I.W. Although, numerically, the models did not attain the high figure of the 1951 exhibition, the quality drew praise from the two judges, Messrs. R. G. Bosberry (Fareham) and T. A. Bedford (Portsmouth).

Many new models were on view and with two exceptions all the models were built on the island. In spite of the popularity of ships, some superb models of locomotives, traction engines, road rollers, aircraft and stationary engines were to be seen. Many of the stationary engines were running on either steam or compressed air. The railway section was well represented by a display of several 2½-in. and 3½-in. gauge locomotives (thanks to our friend "L.B.S.C."). The "OO"-gauge electric system was the work of Mr. D. Martin, of Cowes, and was the centre of much interest to young and old.

The smallest engine in the show was a 0.3 c.c. capacity i.c. engine made by Mr. Eric Heber, of East Cowes, who, with Mr. N. Gawler, shared the responsibility of the radio-controlled section of the show.

The cinema, a new feature of this year's show, was operated by Mr. K. Vincent, of Cowes, who showed films of the island railways and of the society's locomotive trials held earlier in the year at Gurnard.

In contrast to the general trend of models were two exhibits, namely, a violin made by Mr. A. Rowe (Newport) and a wool-winder designed and built by Mr. R. Fairhurst, of Stockport, Cheshire.

Another highlight was the loan, by Saunders-Roe, of their wind-tunnel model of the 140-ton "Princess" flying boat which had made its maiden flight during the exhibition week. The 1/48th scale model which has a wing span of 5 ft., its ten propellers electrically driven, was used in the development of the prototype.

The society's championship cup and also the ships' trophy (which is a ship's bell) was won by Mr. A. C. Hayles, of Ryde, with his fine scale model of the Stuart Royal yacht.

The visitors' cup was won by Mr. T. W. Littlewood with a 1922 model of H.M.S. *Superb*.

The society's portable locomotive track was in constant use, the operating duties being shared by R. G. Shepard's "L.B.S.C." *Maisie*, P. Shotter's L.N.E.R. *Hielan' Lassie* and S. Slade's "9400" G.W.R. class pannier tank.

PRACTICAL LETTERS

An Enlarged Model Escapement

DEAR SIR—The photograph reproduced herewith is a model enlargement of a watch escapement which has been quite an attraction in the trade for window display, and I thought it may appeal to some of your readers interested in the horological side.

The base is 10 in. × 6 in., and with balance cock and escape cock, is of straight grain finish aluminium.

The balance is of bronze, which has a very pleasing gold colour, in contrast to the large ruby endstone, the size of balance is $4\frac{1}{2}$ in. dia. at rim with $\frac{3}{8}$ in. balance screws ; the escape-wheel was cut by hand, as also was the lever, from $\frac{1}{8}$ in. sheet brass.

The maintaining power is by ordinary electric clock motor unit, which runs continually at the same speed as the escape wheel runs down, which itself is driven by two pocket-size mainsprings, in tandem, the mainsprings always being about half wound.

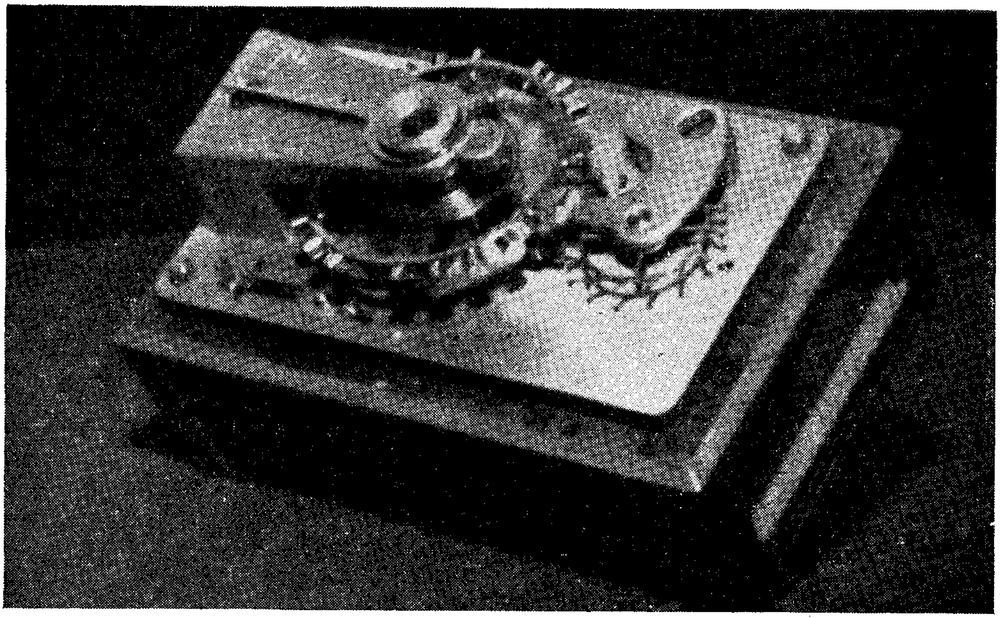
It is fitted with clutch in case of overwinding, and will start on its own in the case of a cut, as it always stops on impulse.

The whole is lacquered to retain finish, and fitted with Perspex cover, bent lengthwise, to give an unobstructed view.

It is exactly eight times the actual size, but at first sight it appears much more ; the tick is not very loud, and does not annoy ; it is not used to tell the time, but solely for demonstration of the principle of the escapement—it could no doubt be made to drive a time dial.

Yours faithfully,

Bradford. A. LAMBERT.



Twist Drill Grinding

DEAR SIR,—I would like to add a comment to the numerous letters which you have received *re* twist drill grinding.

I have, since the age of 15 years, been hand grinding drill points in the range No. 70 to $1\frac{1}{2}$ in. dia., and do not recall either oval holes or excessive oversize holes resulting.

Furthermore, I have been closely connected with several twist drill manufacturers and can vouch that the great majority of "jobbers series" twist drills are also hand pointed.

It is my contention that any chap worth his salt can master this simplest of all methods of pointing in ten minutes' practice.

Small Uniflow Engine

I have constructed an engine on a similar principle to that mentioned in "Queries and Replies" in the July 31st issue and inspired by the article referred to (November 3rd, 1949).

My engine, which is an experimental one, is 1 in. bore and stroke, and will run quite happily on as little as 5 lb. of *air*.

It was recently on show in Sheffield, and appeared to create quite a measure of interest.

Yours faithfully,

Dronfield. R. HOWE.

The Universal Dividing Head

DEAR SIR,—I was extremely interested in reading of Mr. Hall's (September 4th issue) troubles in building Mr. Turpin's design of the dividing head.

I, too, had my troubles in the short time it took to make it, but mostly through not following instructions. I scrapped a worm wheel the first time, because I didn't put spiral flutes in the hob as instructed, and because I didn't turn the hob in the worm wheel by hand, to make a complete turn of the worm wheel.

I am sorry that Mr. Hall had to pay so much for worm wheel castings, but I am sure he could have purchased a slice of brass bar much cheaper, and good enough for the job. I was lucky in getting sufficient metal from one of the members of our society.

The plates I made out of steel, first because it would look more "professional" and secondly because it was cheaper. I happened to have a piece of mild-steel oven plate to hand after we had had a modern grate put in our house. I borrowed a division plate to put in some of the holes and the remainder I drilled by the help of my change wheels. There are very few divisions that cannot be got by using holes 55, 50, 45, 40, 35, 30, 20, in conjunction with a 40-tooth worm wheel.

I had to dish and spigot the cover plate over the sector arms, as Mr. Turpin explained in his answer, but Mr. Hall, you were caught out on the sector arms; Mr. Turpin gave ample instructions and details of them.

I am pleased with the machine, but I am sorry to state that you need an extension on your cross-slide if you have to cut gears, etc., with the cutter arbor running in the lathe. This I overcame by the slotted plated mentioned in my letter of June 24th issue, and in the issue September 4th, 1952, there is an illustration showing it at the exhibition held in Sheffield; it serves a triple purpose.

I wonder if Mr. Turpin could be prevailed upon to design a milling spindle for the machine, one with a good stout mandrel to take a $\frac{1}{2}$ in. or bigger end-mill. The one I would desire would be worm-driven if required, and driven by a flexible shaft. And then, it might be possible to fasten the column on the bed of the lathe and use the cross-slide as a milling table.

Mr. Hall does not live far from Manchester, and if he should care to contact me at the monthly meetings of the Northern Association of Model Engineers, I would be pleased to meet him.

Yours faithfully,
F. J. HAYNES,
Manchester S.M.E.E

CLUB ANNOUNCEMENTS

The Society of Model and Experimental Engineers

The first "track" meeting of the current programme will take place at the society's headquarters, 28, Wanless Road, at 2.30 p.m., on Saturday, September 27th. There will be two tracks in operation, thanks to the kindness of the North London Society in lending an additional track. Locomotive owners are invited to make use of this opportunity to show the capabilities of their engines, and would-be drivers should take the chance to receive driving instruction. Visitors will be welcome. Full particulars of the society may be obtained from the Secretary, E. C. YALDEN, 31, Longdon Wood, Keston, Kent.

Eltham and District Locomotive Society

The next meeting will be held at the Beehive Hotel, Eltham, at 7.30 p.m., on Thursday October 2nd, 1952, when Mr. F. Card will bring along the chassis and boiler parts of $3\frac{1}{2}$-in. gauge *Tich*, now under construction. At the last meeting new members came along with their problems, the chairman and several members gave their opinions, and described the best methods to be adopted, and which proved to be of great help. Mr. Calver has also promised to bring along his chassis in the near future. It is hoped that members will bring along work upon which they are engaged when attending meetings, as did our treasurer, Mr. S. Brock, who placed one of his beautifully finished cylinders of his next locomotive on the table for inspection.

It is hoped to provide a series of talks and discussions during the winter months, for the benefit of new members and beginners now building locomotives. Mr. Mace, of Welling, attended the last meeting as a visitor; he is now engaged in building a "Juliet."

Hon. Secretary: F. BRADFORD, 19, South Park Crescent, S.E.6.

Wakefield Society of Model and Experimental Engineers

Meetings of the society will be as follows:—

Wednesday, October 8th. Two films, each running approximately half an hour, entitled "The Pioneer's Progress" and "Three Installations," kindly loaned by Messrs. Richard Sutcliffe Ltd., Horbury. These films show how various mechanical handling problems were solved by the application of conveyors, and are very interesting from an engineering point of view.

The above meeting will be held at St. Michael's School, Grange Street, Wakefield, at 7.30 p.m., and visitors will be welcome.

Wednesday, October 22nd. On this date we hope to visit the works of Messrs. Bagley & Co. Ltd., Glass Bottle Works, Knottingley.

Our portable track has now been well tested, having been in use at three galas, and is in every way a success. The track was in use at Pontefract on September 6th, at a gala in aid of church funds, when approximately 700 passengers were carried. To date, the track has earned a useful amount for club funds and we are assured of several bookings for next season.

Hon. Secretary: D. S. HILL, 46, Elmwood Grove, Horbury.

The Farnborough Society of Model Engineers

Future visits of the above society are as follows:—

October 4th. Visit to Thornycrofts, Basingstoke Works also S.R. sheds.

October 6th. Visit to Gale & Polden Printing Works, Aldershot.

October 9th. Visit to Longmoor Military Railway.

November 16th. Visit to W.R. sheds at Reading.

November 27th. First A.G.M.

The 4 mm. scale layout, 15 ft. × 15 ft., which caters for both 16.5 mm. and 18 mm. gauges is nearing completion. The "O" gauge group have started constructing a portable layout.

Full details regarding the club can be obtained from the Hon. Secretary, D. L. JENKINS, 16, Hurst Road, Hawley Estate, Farnborough, Hants.

The Bath and District Society of Model and Experimental Engineers

On Friday, September 26th, at 7.30 p.m., a visit will be paid to the garage of Messrs. E. & V. Sims, members of the society, where a veteran car, which they have recently acquired, will be shown.

Hon. Secretary: A. SMITH, "Redtiles," Rodney Road Saltford, Somerset.